GOLDEN GATE BRIDGE, HIGHWAY AND TRANSPORTATION DISTRICT

GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

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OCTOBER 1982

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October 1, 1982

Mr. Dan E. Mohn
District Engineer
Golden Gate Bridge, Highway
and Transportation District
Box 9000, Presidio Station
San Francisco, California 94129

Re: Golden Gate Bridge
Toll Plaza Master Plan

Dear Dan:

In accordance with Board Resolution No. 81-395 we are submitting herewith our report for a master plan of the Golden Gate Bridge toll plaza complex. This report is intended to provide the necessary information to proceed with a more detailed preliminary design prior to obtaining permits and funding the project.

We were assisted in this study by Robert B. Wong, AIA, who in his capacity as Associated Architect developed the conceptual design of the new administration building, toll building and related facilities.

We are available to meet with you and your staff at your convenience for a more detailed discussion of our study.

We gratefully acknowledge the cooperation and advice received from your staff and wish to express our appreciation for having been retained by you for this assignment.

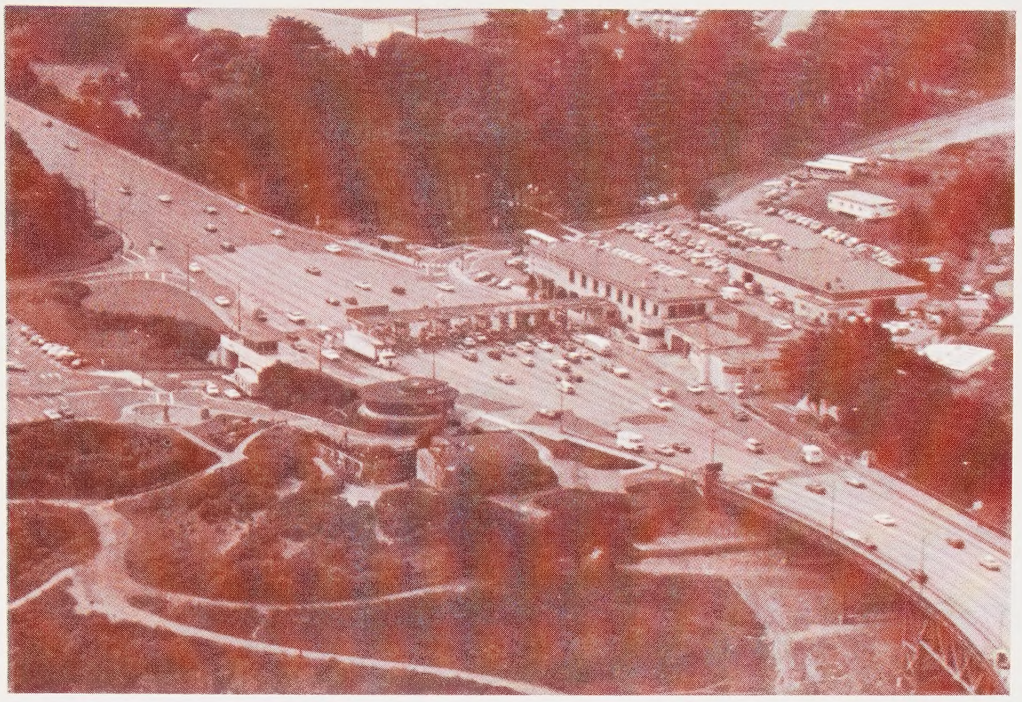
Very truly yours,

AMMANN & WHITNEY

Allen M. Custen - C 28619
Partner

FS/ky

GOLDEN GATE BRIDGE, HIGHWAY AND TRANSPORTATION DISTRICT



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INTRODUCTION

The 1969 report on the structural inspection of the Golden Gate Bridge recommended certain repairs and improvements to return the Bridge to first-class condition. This recommended work either has been completed or is now in progress. Upon its completion the Bridge will structurally be in excellent shape and ready to serve the Bay Area for many decades to come. With these structural problems out of the way, it now becomes appropriate for the District to consider operational improvements of the Bridge, and in particular of the toll plaza.

The capacity of the Golden Gate Bridge toll plaza to adequately and efficiently serve present and anticipated future traffic needs has long been of concern to the District. Traffic delays in connection with recent toll changes as well as plans for a replacement of the toll booths and toll registry system have given impetus to a thorough review of the entire toll plaza complex.

Board Resolution 81-326 authorized a masterplan study of the toll plaza to provide for a solution to the problems caused by the present configuration and current and future traffic demands. This report summarizes the results of this study and presents conclusions and recommendations.

SUMMARY

The present toll plaza layout was investigated for possible improvements of traffic handling capacity. All analyses indicated that there is no available short term solution which would increase capacity and safety in a cost effective manner. Additionally, the toll booths are antiquated and have reached a state where further repairs and improvements are impossible.

Various locations and layouts for a new toll plaza for both southbound and northbound toll collection were subjected to an initial screening and eight schemes were further investigated in detail. After analyzing their traffic-handling capabilities and environmental features, a new toll plaza located approximately 400 feet south of the present plaza was selected and is recommended for adoption.

The recommended plaza is located just north of the Lincoln Boulevard underpass. It will provide a total of 18 lanes: 14 lanes for southbound toll collection and 4 wide lanes for unobstructed movement for northbound traffic from Doyle Drive and 19th Avenue directly onto the Bridge. New ramps will be constructed for southbound traffic to and from Lincoln Boulevard and a separated traffic lane will bring northbound traffic to Lincoln Boulevard and the public parking area.

The recommended scheme will require the relocation of the existing Administration Building Complex and the Computer Building. A new toll office building, including related facilities will be

constructed on the west side of the new plaza, approximately in the location of the present Computer Building. The new Administration Building, including enlarged parking facilities, will be located uphill from the present employee parking lot. This new complex will permit the consolidation of various District operations presently spread over several locations in San Francisco and Marin County. The shop building and maintenance area will not be affected by the recommended scheme; however, redevelopment of the land owned by the District west of the present plaza will permit the construction of additional needed maintenance and storage facilities.

Merchant Road will be largely abandoned and a new access to the District facilities will be provided from Lincoln Boulevard. The vehicular tunnel under the present toll plaza will be extended to provide continued access from the District maintenance area to the east public parking area and the Bridge.

Construction of the new plaza can be accomplished without seriously impeding the ongoing operation of the present plaza.

The proposed plaza scheme will have no significant impact on the environment.

The total construction cost of the new plaza, including new administration building complex, toll office building and new toll booths is estimated at 14.3 Million Dollars.

BACKGROUND OF MASTER PLAN STUDY

A. Historical Development of Plaza

The Toll Plaza was originally designed and constructed for a total of 14 toll lanes - seven lanes in each direction - for 2-way toll collection (Fig. 1). This design was predicated on the traffic forecast available at that time, which anticipated that a total of 10,500,000 vehicles would use the Bridge by 1970. Actually, the year 1970 saw nearly 33 million vehicles cross the Golden Gate Bridge, and by 1978 traffic had passed the 36 million mark (Fig. 2).

Immediately after World War II, the popularity of the automobile and the resultant traffic started to increase tremendously and it soon became apparent that the capacity of the bridge toll plaza was insufficient to handle the ever increasing traffic flow. A plan proposed for toll plaza modernization in 1961 recommended the conversion of the existing plaza into 12 northbound toll lanes and the construction of a new 12-lane southbound toll collection plaza to the west of the administration building. Included in this plan was the construction of an entirely new southbound roadway branching off the existing viaduct approximately at Pylon S2, and the construction of new maintenance facilities. The only improvement resulting from this study was the local widening of the west curb leading into the toll plaza in 1964.

Other studies to improve the functioning of the toll plaza were conducted in connection with the lower deck concept study in 1967 and for one-way toll collection in 1969.

One-way toll collection was adopted in late 1968. Subsequently, the original toll lanes No. 10, 12 and 14 were modified to provide a widened toll lane No. 10 and an extra wide lane for oversize vehicles, reducing the total number of lanes through the plaza to thirteen. Since the adoption of one-way tolls, the toll plaza has generally been able to handle the traffic volume, except for periods during the height of the weekday morning commute hours, on some Friday evenings and on Sunday afternoons. However, the steady annual increase in traffic and the inadequate roadway width through the toll lanes for northbound traffic is beginning to errode the ability of the toll plaza to handle traffic in an efficient manner.

Serious traffic delays were encountered as a result of recent toll changes. The collection of a $1.25 toll, instituted in March 1981, had to be abandoned in favor of a mixed toll of $1.00 from Sunday through Thursday and $2.00 on Fridays and Saturdays. These recent problems together with the District's plans for construction of entirely new toll booths and a modernization of the toll registry system has prompted the present master plan study of the toll plaza.

B. Present Deficiencies

Several and distinctly different basic problems contribute to the inadequacy and inefficiency of the present toll plaza and make the plaza the bottleneck for the operation of the entire bridge. These are:

1. The age and condition of the toll booths
2. The short traffic flare distance between the end of the Bridge and the toll booths for southbound toll collection
3. The increasing volume of northbound morning commute traffic
4. The curved alignment through the toll gates which causes speed and lane capacity reductions for northbound evening commute and weekend traffic

Basically, all problems relate to the fact that the plaza is nearly 50 years old and was built for a traffic density and speed of a bygone era. The toll lanes are very narrow by today's standards and the booths are antiquated. They have now reached a state where further repairs and improvements are not only uneconomical but nearly impossible. Replacement of the booth structures and canopy can no longer be delayed.

The other problems are directly related to the layout of the plaza iteself. The lane-by-lane records of the District indicate that during the morning commute period more than 600 vehicles per hour can be handled by one toll lane (Fig. 3). If all twelve toll

lanes employed during the 7:00 to 9:00 a.m. commute period were equally efficient, the rated capacity of the four-lane commute configuration (7200 vehicles) could easily be accommodated by the present twelve toll lanes. As the records indicate, only four toll lanes normally reach or exceed this 600 vehicle mark. This gross under-utilization of available toll lanes is primarily caused by the tight-radius curve leading from the bridge into the plaza and the insufficient approach length which prevents proper spread of vehicles over the full width of the plaza. In particular, the two toll lanes on either side of the plaza (lanes 13, 11, 10 and 8) are considerably under-utilized. Tight merge conditions and narrow lanes for trucks and buses have been a long-standing problem contributing to the under-utilization of toll lanes 11 and 13. The short length of diverge and tight merge conditions cause the under-utilization of lanes 8 and 10.

Toll collection during the evening commute period indicates a similar pattern of under-utilization of the outside toll lanes due to the tendency of drivers to follow the natural flow of the curved approach alignment.

Conditions in the toll plaza are usually the worst on Friday evenings when only a maximum of seven toll lanes can be made available for southbound traffic, and on Sunday evenings when, depending on northbound traffic volume, ten or eleven toll lanes are available. Toll lane capacity rarely exceeds 400 vehicles per hour.

The unfamiliarity of the many vacationers and occasional drivers with the toll system and plaza layout - in contrast to the almost automatic reaction of the daily commuters - adds appreciable to the reduction in toll lane capacity experienced on weekends.

Other highly objectionable features of the present plaza layout affect northbound traffic operations. In order to make the maximum number of toll lanes available for the morning southbound commute traffic, northbound traffic is restricted to a single, sharply curved lane through the plaza and into the bridge almost to the south tower. Traffic capacity of this one lane can be greatly affected by slow moving vehicles and a breakdown will bring all northbound traffic to a stop.

Initially this single lane operation was put into use between 7:00 a.m. and 9:00 a.m., for the major portion of the morning commute period. Lately, an increase in northbound commute traffic has been experienced. Northbound volume now exceeds the 1800 car capacity of a single lane as early as 8:15 a.m., requiring the allocation of two lanes through the plaza for northbound traffic and correspondingly reducing southbound capacity at a critical time.

During normal bridge operating hours (3 lanes each way), evening commute hours and on weekends, northbound traffic must navigate the narrow lanes between toll booths. Because the curved approach to these toll lanes and the merger conditions beyond the booths provide unsatisfactory traffic conditions, a speed restriction has been

posted for northbound traffic through the toll lanes. Even though this restriction is generally ignored by most motorists, lane capacity is considerably and adversely affected.

The Golden Gate Bridge remains the only large toll facility where toll-free traffic is required to pass through constricted toll lanes.

C. Present and Future Traffic Requirements

The capacity requirements for the toll plaza are governed by the number of bridge lanes carrying traffic into the plaza. Of the six available lanes, four lanes are normally used southbound and two lanes northbound during morning commute hours; four lanes northbound and two lanes southbound during evening commute hours; and three lanes in each direction during off-peak day time hours. During the height of the Sunday afternoon traffic peak, four southbound and two northbound lanes are used if traffic conditions so dictate. Plaza capacity is further controlled by the capacity of the approach roads. Highway 101 on Waldo Grade is limited to four lanes in each direction. Physical and environmental constraints as well as cost factors make widening any time in the future highly unlikely. Thus, the four lanes in each direction on Waldo Grade plus the limited traffic on Alexander Avenue to and from Sausalito provide the maximum traffic capacity which the bridge and the toll plaza must be capable of handling.

The rated capacity of each lane on the bridge is 1800 vehicles per hour, or 7200 vehicles per hour for the four-lane commute period configuration of the bridge. The hourly vehicle counts of the District for the last 30 months (from January 1980 through June 1982) indicate that counts of over 7,000 vehicles per hour have been experienced during the Monday through Friday commute period between the hours of 7:00 and 9:00 a.m. on only 36 days, or 2.8 percent of the total number of weekdays. During this period the count exceeded 7,000 vehicles on 27 days between 7:00 and 8:00 a.m. and on 9 days between 8:00 and 9:00 a.m. The maximum count registered during this 30 month period was 7,236 vehicles per hour on only one occasion. The average count for this entire period was 6220 vehicles per hour.

For brief periods between the hours of 7:00 and 8:00 a.m., the traffic may appear to exceed the 7200 vehicle per hour rate. Traffic counts at the north end of the bridge have on occasion indicated a temporary flow of 7800 vehicles per hour, equivalent to 4-lane bumper-to-bumper traffic moving at 20 miles per hour. This local congestion is normally of short duration and of insignificant effect on the hourly rate of vehicles passing through the plaza area, as indicated by the records.

Traffic records during the same 30-month period for City-bound traffic on Sunday afternoons between 4:00 p.m. and 7:00 p.m. indicate 194 counts (49 percent) of over 4,000 vehicles per hour and 4 counts

(one percent) of over 5,000 vehicles per hour. The maximum rate experienced was 5245 vehicles per hour and the average for the entire period was 3774 vehicles per hour.

Generally, traffic volume in the Bay Area continues its slow and steady annual increase. Golden Gate Bridge traffic has increased by one to two percentage points yearly since the fuel-crisis caused drop in 1974. Specifically, the increase was 1.07 percent in 1980 and 2.06 percent in 1981. This increase is expected to continue.

Irrespective of the accuracy or validity of travel surveys, projections of traffic growth and transportation forecasts, the traffic capacity of the Golden Gate Bridge and its highway approaches, consisting of the Doyle Drive to the south and the portion of Highway 101 across Waldo Grade to the north is controlled by the available lanes on the bridge itself. According to information supplied by the California Department of Transportation, this highway system is closely balanced now and will remain so unless the bridge capacity or the approach capacity is increased. There are no plans, present or in the foreseeable future, for an increase in the number of available traffic lanes on the bridge or on the immediate approaches on either side. (Plans prepared by Caltrans several years ago for a widening of Doyle Drive and subsequently shelved, provided four fixed lanes in each direction, equivalent to the present commute period usage of the Bridge and Doyle Drive.)

Any increase in traffic density must, therefore, adapt itself to the available capacity of the traffic corridor. Hourly lane capacity during weekday commute hours is, at present, rarely fully utilized. As traffic increases and begins to saturate available capacity, a change in commute habits and an increase in the daily length of the commute period will result.

PLAZA CAPACITY REQUIREMENTS

The major deficiency of the present toll plaza is its geometric layout which was never designed for today's traffic speed and volume and which is responsible for the unequal distribution of traffic and under-utilization of available toll lanes. Any new plaza must be designed to correct these objectionable features.

For a balanced design of any new toll plaza, its capacity must be based on the rated capacity of the bridge with a moderate allowance for traffic delays caused by accidents or malfunctioning equipment. For the rated capacity of the four-lane morning commute period configuration of 7200 vehicles per hour, and a capability to handle 600 vehicles per hour per toll booths, 12 toll lanes would be required. Experience during the time of $1.25 toll collection indicates that for this and similar tolls 550 vehicles can be handled per toll lane per hour. For this toll structure, 13 toll lanes would be required to accomodate the rated capacity of the Bridge. To make allowance for a slightly uneven distribution of vehicles and other delay causing factors, 14 toll lanes would be a desirable optimum. Of these toll lanes, at least one lane should be for exclusive use by buses and other toll-exempt traffic at all times. The two outside lanes should provide extra width for buses and trucks.

Four lanes are necessary for the free passage of traffic in the direction opposite to the direction of toll collection. Thus, a total of 18 lanes through a properly aligned toll plaza would be the optimum desirable arrangement.

Plaza layout and ramp locations must be designed to facilitate traffic movements to and from downtown, 19th Avenue and 25th Avenue (Fig. 4).

LOCATION STUDIES

Various locations and layouts for a new toll plaza for both southbound and northbound toll collection were subjected to an initial screening and the most promising schemes were further investigated in detail. These schemes are:

A. Northbound Toll Collection in Existing Plaza

B. Southbound By-pass Road

C. Widening of Existing Plaza Westward

D. New Plaza 400 ft. South of Existing Plaza

E. New Plaza 600 Ft. South of Existing Plaza

F. Northbound Toll Collection in Relocated Plaza

G. South-Bound Plaza at North End of Bridge

H. North-Bound Plaza at North End of Bridge

I. Tandem Toll Booth

These schemes are discussed in detail below.

A. NORTHBOUND TOLL COLLECTION IN EXISTING PLAZA

1. General Description

Under this scheme, the direction of toll collection would be reversed from southbound to northbound collection. Extensive modifications will be required for booths and canopy structure but no improvements will result to the operation of existing plaza.

2. Alignment and Operational Features

Toll collection in the northbound direction during the morning commute period could be handled comfortably with 6 toll lanes. This would provide a smooth merge into the two available lanes on the bridge itself. For southbound four lane traffic, 8 lanes through the toll plaza would be available; however, all but 2 lanes would pass through the toll lanes used at other times for northbound toll collection.

During evening commute hours, the two-lane toll-free southbound traffic from the Bridge could be handled by two lanes through the plaza, leaving twelve toll lanes to handle northbound toll traffic. The straight approach into the plaza would facilitate equal distribution of traffic across all toll lanes. However, the normal congestion on the plaza approach will increase difficulties for vehicles from Doyle Drive wishing to exit to Lincoln Boulevard and the East parking lot. A separate toll lane will have to be provided for northbound traffic entering from Lincoln Boulevard and the East parking lot.

Merge conditions for northbound evening commute traffic from the toll plaza uphill into the bridge are extremely unfavorable and will reduce normal toll lane capacity considerably. The necessary relocation of the northbound bus stop into the area between the toll gates and the bridge will further contribute to the congestion.

The combined storage capacity of the four-lane Doyle Drive approach from its junction with the entrance from Lombard Street and of the 19th Avenue ramp from Funston Tunnel approximately equals the storage capacity presently provided in the southbound direction from the toll plaza to the end of the Marin Approach. Any need for larger storage as may be occasioned by accidents or heavy weekend traffic may spill over into City streets.

3. Effect on Existing District Facilities

Adequate access must be provided for toll takers across the active southbound traffic lanes. This can be accomplished by a new overhead walkway structure which must be fully enclosed for protection against wind, rain and fog; or by an underground tunnel.

The present toll booths for lanes 11 and 13 will be rebuilt and relocated to the east side of the plaza. The remainder of the booths, the canopy and the traffic island protective installation will require extensive modifications. The narrow toll lanes will remain. No other effect on existing facilities is anticipated.

4. Environmental Considerations

The uphill grade towards the Bridge from a standing start at the toll barrier will have a negative effect both on energy consumption and on air quality.

5. Costs

It is estimated that the construction cost to implement northbound toll collection, including moving and rebuilding two toll booths, modification of the remaining toll booths and canopy and installation of safe access for toll collectors, will be approximately $1,350,000.

B. SOUTHBOUND BY-PASS ROAD

1. General Description

District staff, in a study "Toll Plaza Modernization for One Way Toll", dated March 1969, recommended to the Board of Directors the concept of northbound toll collection in the existing plaza and a new southbound by-pass road. The firm of Parsons, Brinckerhoff, Quade & Douglas, Inc. was subsequently engaged to prepare a preliminary design study.

Figures 5 and 6 are taken from the 1970 PBQ&D report. They show the toll plaza improvement recommended at that time. The entire existing toll plaza is used for northbound toll collection. Southbound

traffic by-passes the toll plaza via a new roadway which separates from the present bridge alignment south of the arch span and converges with Doyle Drive south of Lincoln Boulevard.

2. Alignment and Operational Features

The new four-lane roadway facility by-passing the toll plaza is located west of the Administration Building. The total length of new roadway is approximately 2,650 feet, including the transitional flaring section beginning just south of Pylon S-2 of the arch span and including the terminal taper rejoining the existing roadway between Lincoln Boulevard and the Funston Avenue exit ramp. The new roadway is carried on new structure consisting of high steel towers and trusses from the arch span to the headlands, coming to grade just below the present ridge elevation. It continues on grade west of the Administration Building and crosses Lincoln Boulevard on a new overpass structure.

Anticipating difficulties in the construction of new viaduct foundations in the headlands west of the existing construction, the District engaged the firm of Dames & Moore to investigate foundation conditions in conjunction with the PBQ&D study. Deep foundation caissons, extensive regrading and installation of subsurface drains were recommended to avoid potential rock slides.

The new roadway must be constructed for a four-lane width to accomodate morning southbound commute traffic. For the remaining time, when the bridge is operated 3 lanes in each direction, or four lanes northbound, the new roadway will serve only three or two lanes of southbound traffic. Appropriate and safe channelization features must be installed at the by-pass juncture to prevent collisions with on-coming traffic or with the gore parapet.

The new viaduct structure will be located in an area which in the past has caused major maintenance problems due to its exposure to wind, fog and salt spray. Additional and continuing maintenance costs must be anticipated from this new structure.

3. Effect on Existing District Facilities

Even though new access roads are provided to the Administration Building, the south by-pass road in effect isolates the administration building complex and will prevent any future expansion of the facilities.

The entire maintenance complex, computer building and associated parking facilities will have to be relocated.

4. Environmental Considerations

Aesthetically, the topography of the site and the bridge itself have been recognized for decades as singularly beautiful. The new viaduct structure will not only change the appearance of the bridge but will

result in extensive alterations in the topography of the south headlands of the Golden Gate. Battery Cranston will be mostly obliterated.

The new by-pass road will require the removal of pine trees and shrubbery north of the administration building and on either side of Lincoln Boulevard. Lincoln Boulevard has to be re-graded to provide sufficient headroom under the new by-pass structure.

The uphill grade towards the Bridge from a standing start at the toll barrier will have a negative effect both on energy consumption and on air quality. Merger conditions from the toll gate into the bridge will have a negative effect on traffic safety and lane capacity.

5. Costs

The PBQ&D report quoted a preliminary construction cost estimate of $3,257,000 exclusive of new building construction. The current estimated construction cost of the southbound by-pass scheme including relocation and replacement of District facilities, but using the existing toll lanes and toll booths, is $15,000,000. Necessary rebuilding of the toll lanes and toll booths would add another $3,000,000 to this cost.

C. WIDENING OF EXISTING PLAZA WESTWARD

1. General Description

A relocation and widening of the present plaza westward into the area presently occupied by the Administration Building will permit better traffic flow into the plaza and a better utilization of toll lanes, and provide unimpeded traffic flow in the northbound direction, as shown in Figure 7.

2. Alignment and Operational Features

The new toll plaza provides 12 lanes for southbound toll collection and four unobstructed lanes for northbound traffic. In order to provide for smooth traffic movement into the plaza, the three last spans of the approach viaduct must be widened towards the west. This will require the construction of one additional support column each at bent lines 9 and 10 and lengthening of the abutment structure. New southbound ramps for exit to and entrance from Lincoln Boulevard are provided south of the underpass. The exit to 19th Avenue will remain unchanged.

Northbound traffic will have four lanes for unobstructed passage through the plaza area. The northbound exit ramp towards Lincoln Boulevard and the public parking area will remain unchanged; however the northbound entrance ramp will be slightly realigned. New bus stops, in separated traffic lanes, will be provided in both traffic directions. The Lincoln Boulevard Underpass will be widened towards

the west to provide the necessary space for the new toll plaza. This will require local adjustment to the Lincoln Boulevard profile.

Widening and rebuilding of the toll lanes will require intricate staging and the use of temporary toll booths. This will have a temporary detrimental effect on commute traffic through the plaza area.

3. Effect on Existing District Facilities

This scheme will require the relocation of the existig Administration Building complex. A new toll office building, including related facilities will be constructed on the west side of the new plaza. The new Administration Building will be located uphill from the present employee parking lot. This new facility will permit the consolidation of various District operational units presently spread over several locations in San Francisco and Marin County. Merchant Road will be realigned to provide a new access to the District facilities from Lincoln Boulevard. The vehicular tunnel under the present toll plaza will be extended to provide continued access from the District maintenance area to the public parking area and the Bridge.

4. Environmental Considerations

The new toll plaza will improve traffic flow in both directions and thereby result in an improvement of air quality.

The new column and foundation construction for the widening of the approach viaduct will result in minor alterations in the topography of the south headlands of the Golden Gate. The regrading of Lincoln Boulevard and the contour modifications required in connection with the new entrance and exit ramps should have no appreciable effect on ground cover and drainage. However, the new construction will require the removal of several stands of pine trees and shrubbery.

5. Costs

The total construction cost of the new plaza, including new administration building complex, toll office building and new toll booths, is estimated at 12.5 Million Dollars. The new toll registry installation, presently under contract, will be re-installed in the new plaza.

D. NEW PLAZA 400 FT. SOUTH OF EXISTING PLAZA

1. General Description

A new toll plaza for southbound toll collection is located approximately 400 feet south of the present toll plaza, and just north of the Lincoln Boulevard underpass. A plan of the proposed plaza layout is shown in Figure 8.

2. Alignment and Operational Features

The new plaza will provide fourteen lanes for southbound toll collection and the equivalent of five lanes for unobstructed movement of northbound traffic. The increased length from the bridge approach to the plaza and the widening towards the west will permit smooth traffic flow and improve utilization of all toll lanes. Adequate lane length remains between the plaza and the 19th Avenue exit ramp for proper separation of downtown and 19th Avenue-bound traffic. New southbound ramps for exit to and entrance from Lincoln Boulevard are provided south of the underpass.

For northbound traffic, a straight approach leads four lanes coming from Doyle Drive and two lanes from 19th Avenue towards the Bridge. The six lanes will merge into five lanes at the plaza and finally into four lanes (for evening commute traffic) at the bridge entrance. The entrance ramp from Lincoln Boulevard will be realigned and separate exit ramps from Doyle Drive and 19th Avenue will direct traffic towards Lincoln Boulevard and the public parking area.

The Lincoln Boulevard Underpass will be widened towards the west to provide the necessary space for the new toll plaza. This will require local adjustment to the Lincoln Boulevard profile (Figure 9).

New and lengthened District bus stops, in separated lanes, will be provided in both traffic directions. Muni bus stops on Lincoln Boulevard will be connected with the District bus stops by walkways.

The new plaza layout will permit stage construction without seriously impeding operation of the present plaza.

3. Effect on Existing District Facilities

This plaza scheme will require the relocation of the existing Administration Building Complex and the Computer Building. A new toll office building, including related facilities will be constructed on the west side of the new plaza, approximately in the location of the present Computer Building. The new Administration Building, including enlarged parking facilities, will be located uphill from the present employee parking lot. This new complex will permit the consolidation of various District operational units presently spread over several locations in San Francisco and Marin County.

Merchant Road will be largely abandoned and a new access to the District facilities will be provided from Lincoln Boulevard. The vehicular tunnel under the present toll plaza will be extended to provide continued access from the District maintenance area to the east public parking area and the Bridge.

4. Environmental Considerations

The new toll plaza will improve traffic flow in both directions and thereby result in an improvement of air quality. The regrading of Lincoln Boulevard and the contour modifications required in connection with the new entrance and exit ramps will have no

appreciable effect on ground cover and drainage. However, the new construction will require the removal of several stands of pine trees and shrubbery.

5. Costs

The total construction cost of the new plaza, including new administration building complex, toll office building and new toll booths is estimated at 14.3 Million Dollars. The new toll registry installation, presently under contract, will be re-installed in the new plaza.

E. NEW PLAZA 600 FT. SOUTH OF EXISTING PLAZA

1. General Description

A new toll plaza for southbound toll collection is located approximately 600 feet south of the present toll plaza, and just south of the Lincoln Boulevard underpass. A plan of the proposed plaza layout is shown in Figure 10.

2. Alignment and Operational Features

The new plaza will provide fourteen lanes for southbound toll collection and the equivalent of five lanes for unobstructed movement of northbound traffic. This plaza is located approximately half-way between the bridge entrance and the 19th Avenue exit ramp. The length from the bridge approach to the plaza and the widening towards

the west will permit even smoother traffic flow and utilization of all toll lanes then the plaza Scheme D. However, lane length between the plaza and the 19th Avenue exit ramp decreases substantially for the proper separation of downtown and 19th Avenue-bound traffic. New southbound ramps for exit to and entrance from Lincoln Boulevard are provided south of the underpass.

For northbound traffic, a straight approach leads four lanes coming from Doyle Drive and two lanes from 19th Avenue towards the bridge. The six lanes will merge into five lanes at the plaza and finally into four lanes (for evening commute traffic) at the bridge entrance. The entrance ramp from Lincoln Boulevard will be realigned and separate exit ramps from Doyle Drive and 19th Avenue will direct traffic towards Lincoln Boulevard and the public parking area.

The Lincoln Boulevard Underpass will be widened towards the west to provide the necessary space for the new toll plaza. This will require local adjustment to the Lincoln Boulevard profile (Figure 9).

New and lengthened District bus stops, in separated lanes, will be provided in both traffic directions. Muni bus stops on Lincoln Boulevard will be connected with District bus stops by walkways.

The new plaza layout will permit stage construction without seriously impeding operation of the present plaza.

3. Effect On Existing District Facilities

This scheme will require the relocation of the existing Administration Building and Computer Building. The new toll office building, including related facilities and a separate parking area will be constructed on the west side of the new plaza, south of Lincoln Boulevard. The new Administration Building including enlarged parking facilities, will be located uphill from the present employee parking lot. This new complex will permit the consolidation of various District operational units presently spread over several locations in San Francisco and Marin County.

Merchant Road will be largely abandoned and a new access to the District facilities will be provided from Lincoln Boulevard. The vehicular tunnel under the present toll plaza will be extended to provide continued access from the District maintenance area to the east public parking area and the Bridge.

4. Environmental Considerations

The new toll plaza will improve traffic flow in both directions and thereby result in an improvement of air quality. The regrading of Lincoln Boulevard and the contour modifications required in connection with the new entrance and exit ramps should have no appreciable affect on ground cover and drainage. However, the new construction will require the removal of several stands of pine trees and shrubbery.

5. Costs

The total construction cost of the new plaza, including new administration building complex, toll office building and new toll booths is estimated at 14.3 Million Dollars. The new toll registry installation, presently under contract, will be re-installed in the new plaza.

F. NORTHBOUND TOLL COLLECTION IN RELOCATED PLAZA

Northbound toll collection as an alternative to southbound toll collection was investigated for Scheme C, Widening of existing plaza westward; Scheme D, New Plaza 400 ft. south of existing plaza; and Scheme E, New Plaza 600 ft. south of existing plaza.

Northbound toll collection for any of these schemes would not only fail to improve operations but would instead create problems for which solutions would either be costly or unattainable, as follows:

1. Adequate property is not available on the east side of the plaza for the necessary toll office building and emergency vehicle services. Locating these facilities on the west side of the plaza would complicate access for toll takers and would require construction of an access tunnel or a fully enclosed overhead walkway structure.

2. Proper separation of toll-free traffic to Lincoln Boulevard and the east parking area from bridge toll traffic will become difficult, especially on weekends and holidays.

3. For schemes D and E, complicated ramp structures will be necessary, through Presidio property, to lead northbound traffic from Lincoln Boulevard and the east parking area through the toll gates.

4. Merge conditions from the toll gate uphill into the bridge would be extremely unfavorable for scheme C and only marginally better for the other two schemes. Adverse merge conditions will reduce normal toll lane capacity considerably.

5. The limited storage capacity of Doyle Drive and the 19th Avenue connection may create tie-ups of City streets, especially on weekends and holidays.

Based on these serious shortcomings, northbound toll collection for Schemes C, D and E was dropped from further consideration.

G. SOUTH-BOUND PLAZA AT NORTH END OF BRIDGE

1. General Description

A new toll plaza for south-bound toll collection at the north end of the Bridge is located approximately 1,100 ft. north of the north

abutment. A plan of the proposed plaza and revised highway alignment is shown in Figure 11.

2. Alignment and Operational Features

The plaza layout provides for 13 toll lanes in the southbound direction and 4 unobstructed lanes in the northbound direction. In order to provide for a reasonable level area in and leading up to the plaza, considerable cutting of adjacent hills and regrading of both the immediate area and the highway south of Waldo Tunnel will be required. Due to the levelling in the plaza area, the already considerable downgrade from Waldo Tunnel will be further increased.

To keep the northbound upgrade within reasonable limits, an artificial lengthening of the alignment or a new lower tunnel may be required.

The Alexander Avenue interchange will have to be revised considerably to meet the new highway alignment. The present view area will remain largely unaffected.

Highway 101 north of the north abutment of the Marin approach viaduct is under Caltrans jurisdiction. The entire area needed for the new plaza construction and highway realignment is either State-owned or part of the Golden Gate National Recreation Area. Negotiations to acquire the necessary land and to obtain approvals for highway reconstruction will be difficult and time-consuming.

3. Effect on Existing District Facilities

A new toll office building will be constructed in conjunction with the new plaza. The space presently occupied by toll-related functions in the Administration Building will become available for other uses and will relieve the District's space problems.

The present plaza at the south end of the Bridge can be narrowed to regular highway proportions. The space gained on the west side will provide better access to the Administration Building, whereas the recovered area on the east side can be utilized to improve the surroundings of the Roundhouse and its functions as a proposed museum.

4. Environmental Considerations

The amount of earthwork required to reshape the proposed plaza area and to regrade the highway, including the possible construction of a new tunnel, will have a significant impact on the topography, ground cover, surface and subsurface drainage, vegetation and scenery. While air quality will be improved at the south end of the Bridge, a considerable lowering of air quality must be expected in the new plaza location where topography provides a natural shelter from cleaning wind currents.

The curved down grade leading into the plaza is highly objectionable from a traffic safety point. Rear end type accidents will be prevalent. The increased upgrade northbound will have a negative effect both on energy consumption and on air quality.

5. Costs

In view of the many doubtful features of this scheme and the improbability of its further consideration, no budget estimate was prepared.

H. NORTH-BOUND PLAZA AT NORTH END OF BRIDGE

1. General Description

A new toll plaza for northbound toll collection at the north end of the Bridge is located approximately 1,300 ft. north of the north abutment. A plan of the proposed plaza and revised highway alignment, is shown in Figure 12.

2. Alignment and Operational Features

The plaza layout provides for 13 toll lanes in the northbound direction and four unobstructed lanes in the southbound direction. Southbound Highway 101 will remain in its present alignment and profile. Grade differences between this highway and the northbound toll plaza will require extensive retaining wall construction.

In order to provide for a reasonably level area in the northbound toll plaza, considerable cutting of hills and regrading will be required both in the immediate plaza area and along the highway leading up Waldo Grade. Due to the levelling in the plaza area, the already steep upgrade may increase beyond the limit recommended for buses and trucks, especially from a dead start at the toll barrier. An artificial stretchout of the alignment to gain grade or a new, lower tunnel may be required.

The Alexander Avenue interchange will have to be revised considerably to meet the new highway alignment. The present view area will remain largely unaffected.

Highway 101 north of the north abutment of the Marin approach viaduct is under Caltrans jurisdiction. The entire area needed for the new plaza construction and highway realignment is either State-owned or part of the Golden Gate National Recreational Area. Negotiations to acquire the necessary land and to obtain approvals for highway reconstruction will be difficult and time-consuming.

3. Effect on Existing District Facilities

A new toll office building will be constructed in conjunction with the new plaza. The space presently occupied by toll-related functions in the Administration Building will become available for other uses and will relieve the District's space problems.

The present plaza at the south end of the Bridge can be narrowed to regular highway proportions. The space gained on the west side will provide better access to the Administration Building, whereas the recovered area on the east side can be utilized to improve the surroundings of the Roundhouse and its functions as a proposed museum.

4. Environmental Considerations

The amount of earthwork required to reshape the proposed plaza area and to regrade the highway, including the possible construction of a new lower tunnel, will have a significant impact on the topography, ground cover, surface and subsurface drainage, vegetation and scenery.

While air quality will be improved at the south end of the Bridge, a considerably lowering of air quality must be expected in the new plaza location where topography provides a natural shelter from cleaning wind currents. The increased upgrade northbound will have a negative effect both on energy consumption and on air quality.

5. Costs

In view of the many doubtful features of this scheme and the improbability of its further consideration, no budget estimate was prepared.

I. TANDEM TOLL BOOTH

1. General Description

A schematic view of the tandem toll booth concept is shown in Fig. 13. For the purpose of this study conclusions reached in a recent study made by the University of California, Berkeley, concerning the efficiency of the tandem toll booth concept, were accepted at face value even though disagreements exist both with certain assumptions made, and certain conclusions reached by the authors of this research specifically with reference to the Golden Gate Bridge.

This study projects an average increase of about 15% in the capacity of a toll lane for adjacent booths and about 25% for the booth spacing of 5 cars recommended for the Golden Gate Bridge. It also cautions that this increase is influenced by the size of the toll, the familiarity of drivers with the toll taking system and by weather conditions.

2. Alignment and Operational Features

Typical toll island configurations for adjacent booths and for tandem booth spacing for a 5 car batch are shown in Figure 14. As shown in Figure 15 and 16, the physical layout of the Golden Gate Bridge plaza with the immediate exit into Merchant Road and the relatively short merge conditions into Doyle Drive and 19th Avenue prohibits the installation of adjacent booth configurations in the two outside lanes (toll lanes 11 and 13) and 5 car batch booths in the three

outside lanes (toll lanes 9, 11 and 13). In addition, tandem toll booths offer no improvement in lanes 9, 11 and 13 since these toll lanes carry the majority of the bus, truck and car pool traffic.

Toll lanes 2, 4, 6, 8 and 10 are used for northbound traffic during evening commute hours and on weekends. The increased length of passage through the narrow toll lane created by the addition of a tandem booth in these lanes will decrease northbound lane capacity and is highly objectionable from a safety point of view.

Thus, practical considerations of plaza operation limit the possible installation of adjacent tandem booths to four lanes (No. 1, 3, 5 and 7, See Fig. No. 15) and to three lanes for batch booth arrangement (lanes 1, 3 and 5; Fig. 16). Of these, only lanes 1 and 3 are fully utilized at present at the height of the morning commute period (Fig. 3). Either of these two options would add less than the equivalent of one full toll lane. As traffic records indicate, delays during the morning commute hours are relatively infrequent, of short duration, and normally concentrated within a brief portion of the commute period.

Major delays occur on Sunday afternoons with weekend travellers returning home in both directions, and on Friday evenings when Marin residents travel into the city. Fewer toll lanes are available during these periods because of the increased demand for lanes in the northbound direction. The University of California, Berekely, studies were based on commute driver behavior and reaction times.

The unfamiliarity of tourists and slower reaction time of weekend drivers using the tandem booth system only occasionally would tend to negate any advantages of this concept and could instead result in an actual reduction in lane capacity on weekends.

Installation of tandem booths will not improve traffic flow in the northbound direction, either during the morning or evening commute period. Thus, even if the installation of tandem toll booths should prove beneficial for toll collections operations, this scheme does not address the other major deficiencies of the present toll plaza.

3. Effect on District Facilities

Supervision and security of the toll collection operations is presently accomplished from the toll sergeants station in the administration building. The additional tandem booths will not be visible from this station. Consequently, supervision and security of the tandem booth collection operations will have to be accomplished by an additional toll sergeant station or by TV monitor.

For proper audit, the toll registry equipment of both tandem toll booths must be interconnected. Electronic hardware to accomplish this is not presently available. A conceptual design has been developed and patented by Mr. Louis D. Rubinstein, P.E. of Los Angeles, Ca. This concept must be modified to meet the specific

requirements of the Bridge registry system and prototype equipment will have to be manufactured, installed and performance-tested prior to actual installation and use on the Bridge.

4. Environmental Consideration

Installation of a tandem booth system will have no impact on present environmental conditions.

5. Costs

The total initial construction cost of installing tandem toll booths in the existing toll plaza, including canopy, traffic islands, utilities and registry equipment, is estimated to be $650,000. Patent rights, proto-type development and testing, and actual equipment costs for the registry inter-tie system are estimated to add about $800,000 to this cost. The annual cost for additional toll collection, supervision and audit staff, is estimated to be $150,000 at current salary rates.

EVALUATION AND RECOMMENDATION

The various toll plaza schemes discussed in the previous chapter were evaluated primarily for their traffic handling capabilities and environmental effects in comparison with the present toll plaza configuration.

Several schemes had to be eliminated for obvious shortcomings, undesirable features or lack of improvement over present conditions:

Northbound toll collection in the existing plaza does not improve traffic flow in the free direction. It would retain the narrow toll lanes and antiquated booths, create unacceptable merge conditions from the plaza into the bridge, and may occasionally cause traffic congestion in City streets.

A southbound by-pass road embodies many features which are not desirable today for environmental, operational and maintenance reasons.

A toll plaza at the north end of the bridge would have to be constructed on land not now owned by the District, would create a major environmental impact and would be prohibitive in cost.

The effect of tandem booths on toll collection, especially on weekends, is problematic. No improvement will be obtained for traffic flow in the free direction and the narrow toll lanes and antiquated booths would be retained.

In order to determine the most effective plaza scheme, a rating system was developed for traffic movement in the toll plaza, traffic movements to northbound and southbound connections and for effects on the enviromment of the various plaza schemes (Table A). A value of 10 has been assigned to the optimum condition, with decreasing values to 1 for least desirable conditions. For comparative purposes, a value of 6 was assigned to the present toll plaza.

From this evaluation, Scheme D "New Plaza 400 ft. South of Existing Plaza" shows the highest mark and is, therefore, recommended for adoption. Because of its greater distance from the 19th Avenue exit ramp it will be preferable to the similar plaza layout 600 ft. south of the existing plaza as shown in Scheme E.

The recommended scheme will require the relocation of the present Administration Building and Computer Building. The necessary replacement facilities are described in the following chapter. The present shop building and maintenance area will not be affected by the recommended plaza construction.

The improvement of the northbound bus stop at the east side of the toll plaza, presently under design by District Staff, can be incorporated into the proposed new toll plaza layout with minor modifications.

Construction of the new toll plaza must be accomplished in several stages. The first stage will be the construction of a new administration building. This will be followed by the demolition of the present administration building and the computer building; the construction of a new toll office building; the construction of the new

plaza including widening of the Lincoln Boulevard Bridge and construction of new ramp connections; and finally the phased erection of the new toll booth and demolition of the existing toll booths.

The total cost of the new toll plaza is estimated to be as follows:

Mobilization	$ 242,000
Demolition, Excavation & Backfilling	816,000
Structural Work	3,898,400
Roadway Work	2,314,600
Maintenance of Traffic	880,000
Utilities	693,000
Buildings	5,456,000
Sub Total =	14,300,000
10% Engineering and Construction Supervision	1,430,000
Total =	$15,730,000

TABLE A
PLAZA RATING

		Present Toll Plaza	Scheme A NB Toll Collection In Existing Plaza	Scheme B Southbound By-Pass Road	Scheme C Widening of Exist. Plaza Westward	Scheme D New Plaza 400 ft. South of Exist. Plaza	Scheme E New Plaza 600 ft. South of Exist. Plaza	Scheme G SB Plaza - North End of Bridge	Scheme H NB Plaza - North End of Bridge	Scheme I Tandem Toll Booth
Plaza Movements	Entrance into toll plaza	6	9	10	8	9	10	4	7	6
	Exit from Toll Plaza	6	4	4	7	7	7	7	3	5
	Travel thru Plaza opposite toll travel	6	4	10	9	10	9	4	6	6
Traffic Movements South-Bound	To Doyle Drive	6	6	8	6	6	5	6	6	6
	To 19th Avenue	6	6	8	6	7	4	6	6	6
	To Lincoln Boulevard	6	6	8	8	9	7	6	6	4
	From Lincoln Boulevard	6	5	7	8	8	8	6	6	5
	From Waldo Grade	6	6	6	6	6	6	3	6	6
	From Alexander Avenue	6	6	6	6	6	6	5	6	6
Traffic Movements North-Bound	From Doyle Drive	6	5	5	8	10	10	6	6	6
	From 19th Avenue	6	5	5	8	10	10	6	6	6
	From Lincoln Boulevard	6	3	3	6	9	9	6	6	6
	To Lincoln Boulevard	6	3	3	6	10	10	6	6	6
	To Waldo Grade	6	6	6	6	6	6	4	3	6
	To Alexander Avenue	6	6	6	6	6	6	6	6	6
Effects on Environment	Air Pollution	6	6	4	7	7	7	4	4	6
	Noise Pollution	6	6	6	6	6	6	4	4	6
	Topography	6	6	2	4	5	5	1	1	6
	Vegetation	6	6	3	4	5	5	4	3	6
	Drainage	6	6	3	5	5	5	2	2	6
	Energy Consumption	6	6	4	7	7	7	3	2	6
	TOTAL	126	116	117	137	154	148	99	101	122

NEW BUILDING FACILITIES

With the re-aligned toll plaza area, it is evident that the administration building must be relocated to a different site.

The present building houses the District's administrative functions as well as those related to toll collection and emergency services. For proper operations, it is important that toll collection administration and emergency services be adjacent to the new toll plaza. The other general administrative functions need not be in the immediate vicinity. Since there is relatively little constant interplay between the general administrative functions and the toll collection/emergency services, it would appear that two separate buildings would serve the District's needs equally well.

The suggested schematic design location (Fig. 17) shows the administration building approximately 275 feet southwest of the toll office building. The area in between is devoted to parking for both buildings. Views of the toll plaza area and the bridge from the administration building are possible because the administration building would be set up higher on the hill.

Many of the District's administrative functions could be consolidated into the new building, including computer services, planning and marketing, drafting, ridesharing and personnel, all of which are currently not located in the present administration building.

Current costs for the buildings are as follows:

Toll office building/emergency services	$1,360,000
Administration building	$3,600,000

FIGURES

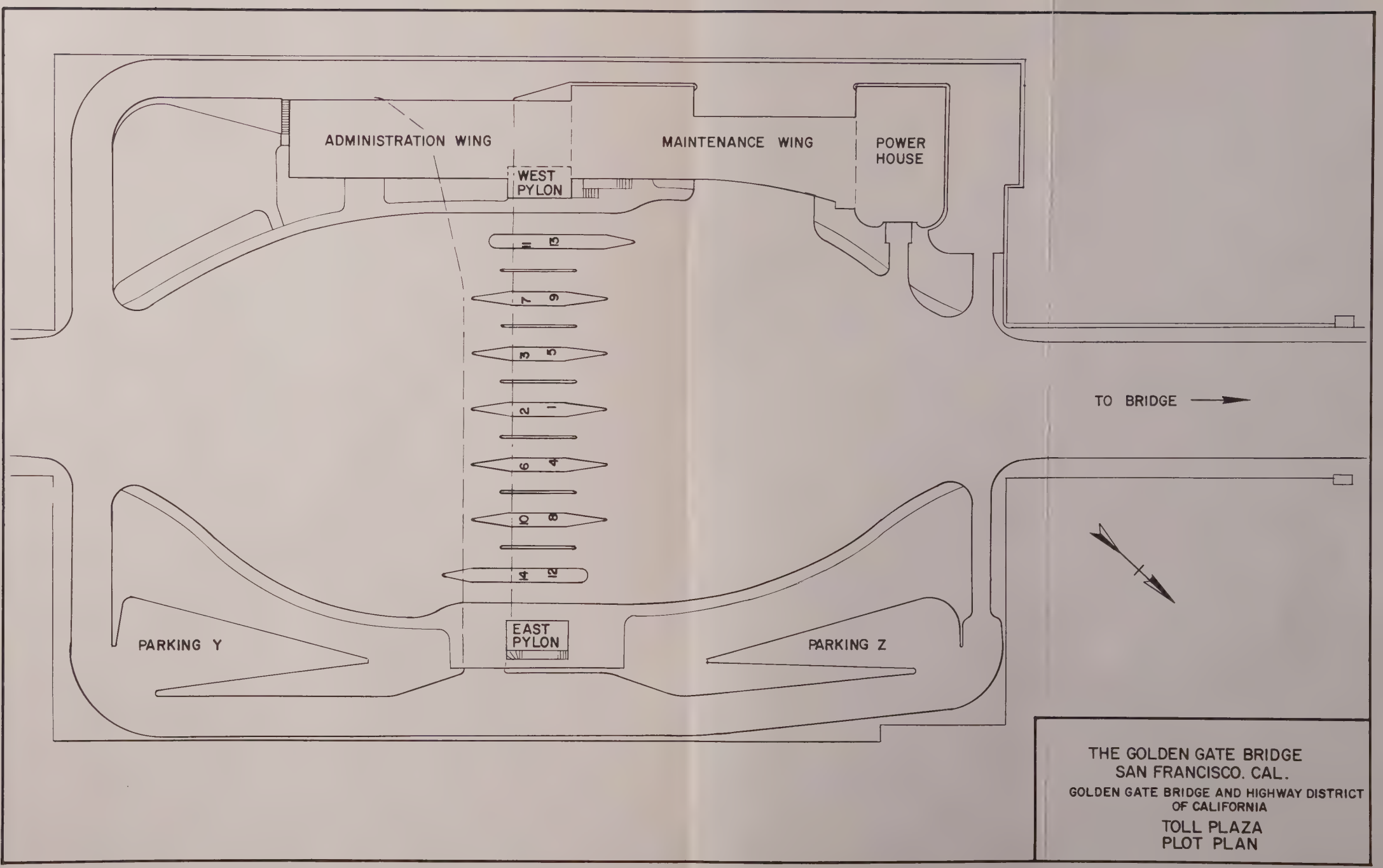
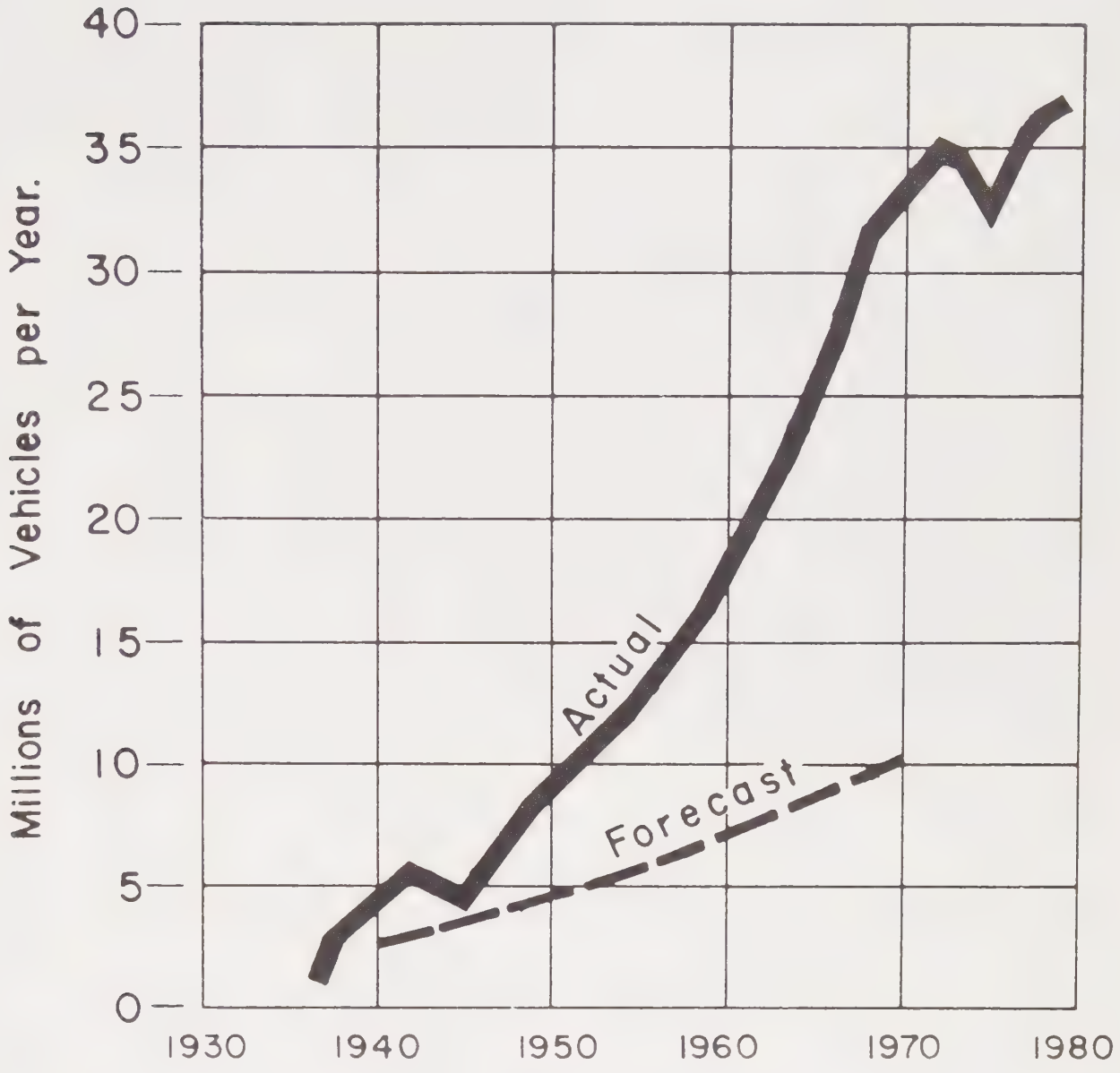

ADMINISTRATION WING
MAINTENANCE WING
POWER HOUSE
WEST PYLON
EAST PYLON
PARKING Y
PARKING Z
TO BRIDGE
11 13
7 9
3 5
2 1
6 4
10 8
14 12
THE GOLDEN GATE BRIDGE
SAN FRANCISCO. CAL.
GOLDEN GATE BRIDGE AND HIGHWAY DISTRICT
OF CALIFORNIA
TOLL PLAZA
PLOT PLAN

FIGURE 1



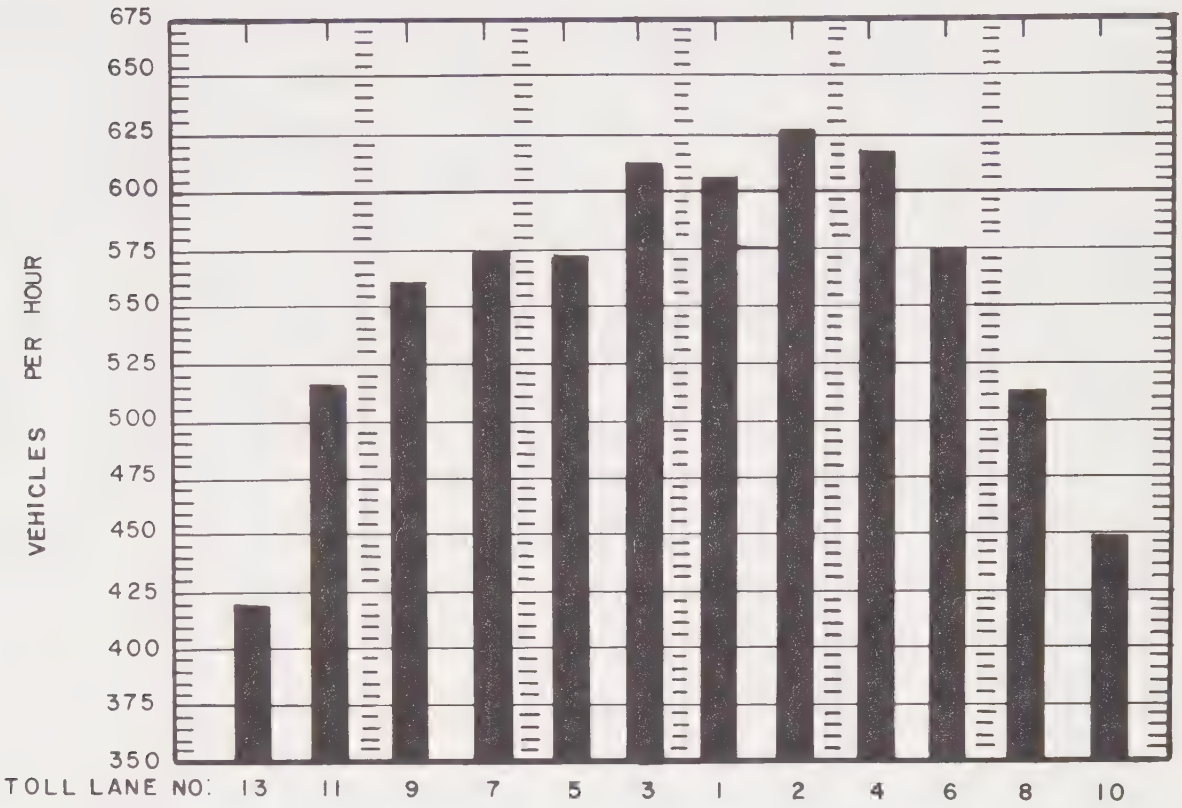
Traffic growth, Golden Gate Bridge.

FIGURE 2

AVERAGE VEHICLES PER LANE MAY 1982

(MONDAYS THROUGH FRIDAYS)

7 AM – 9 AM OVERALL AVERAGE: 553 VEHICLES PER LANE PER HOUR



4 PM – 6 PM OVERALL AVERAGE: 374 VEHICLES PER LANE PER HOUR

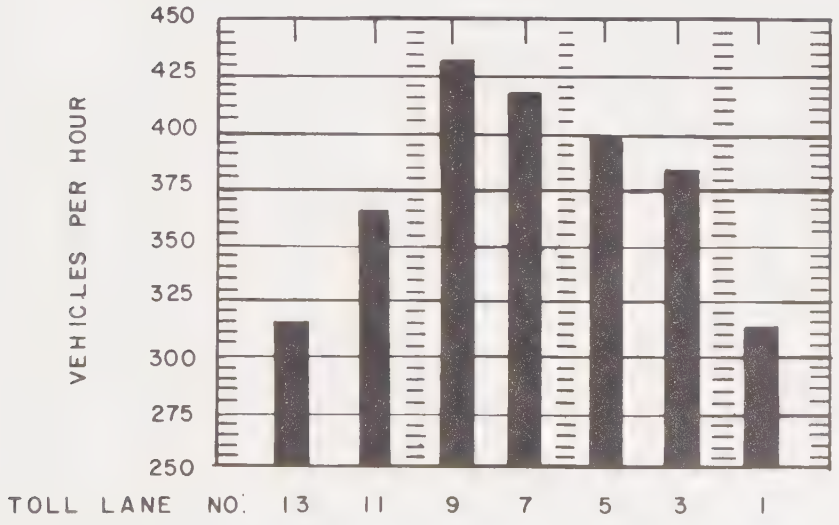
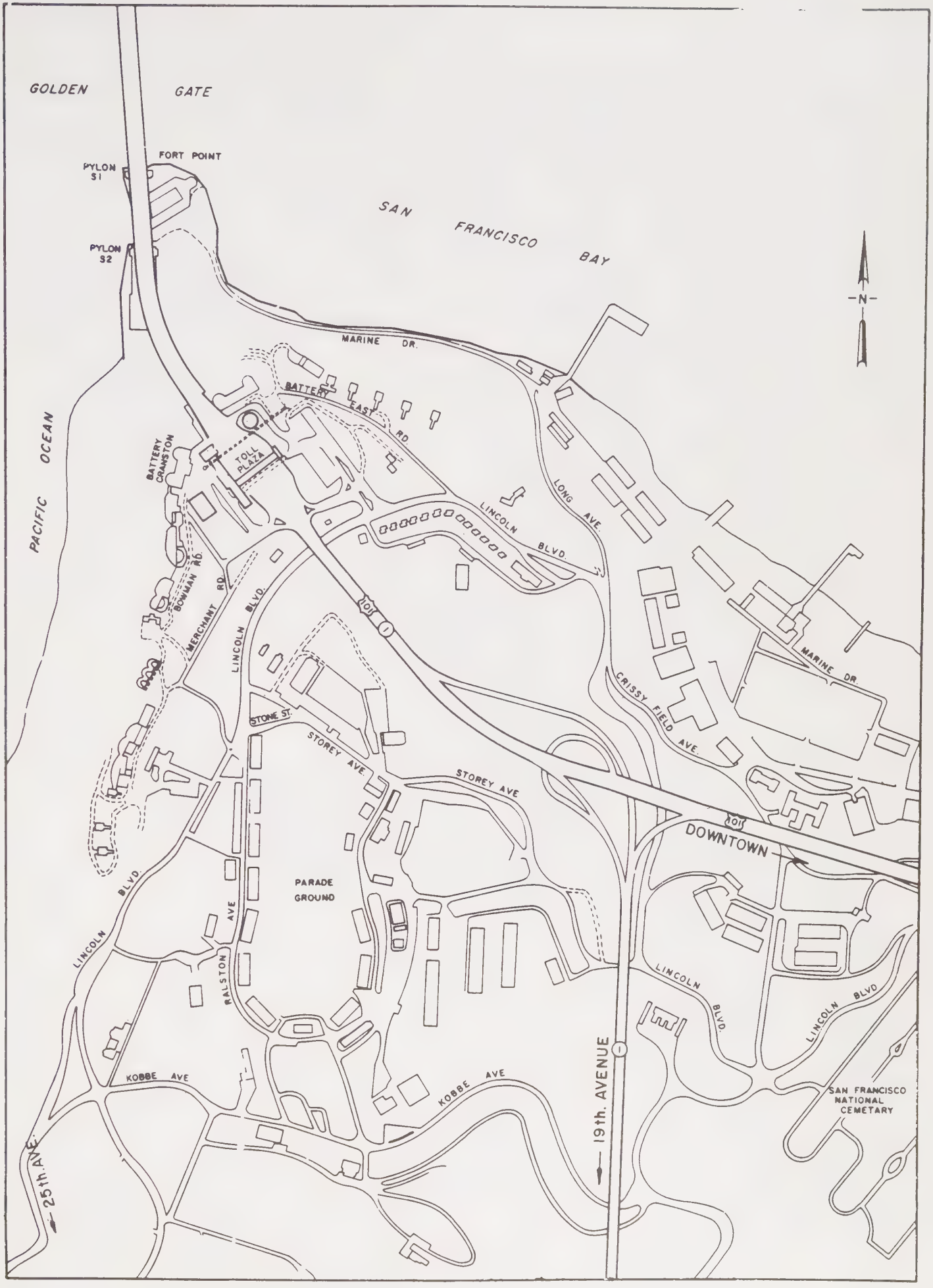
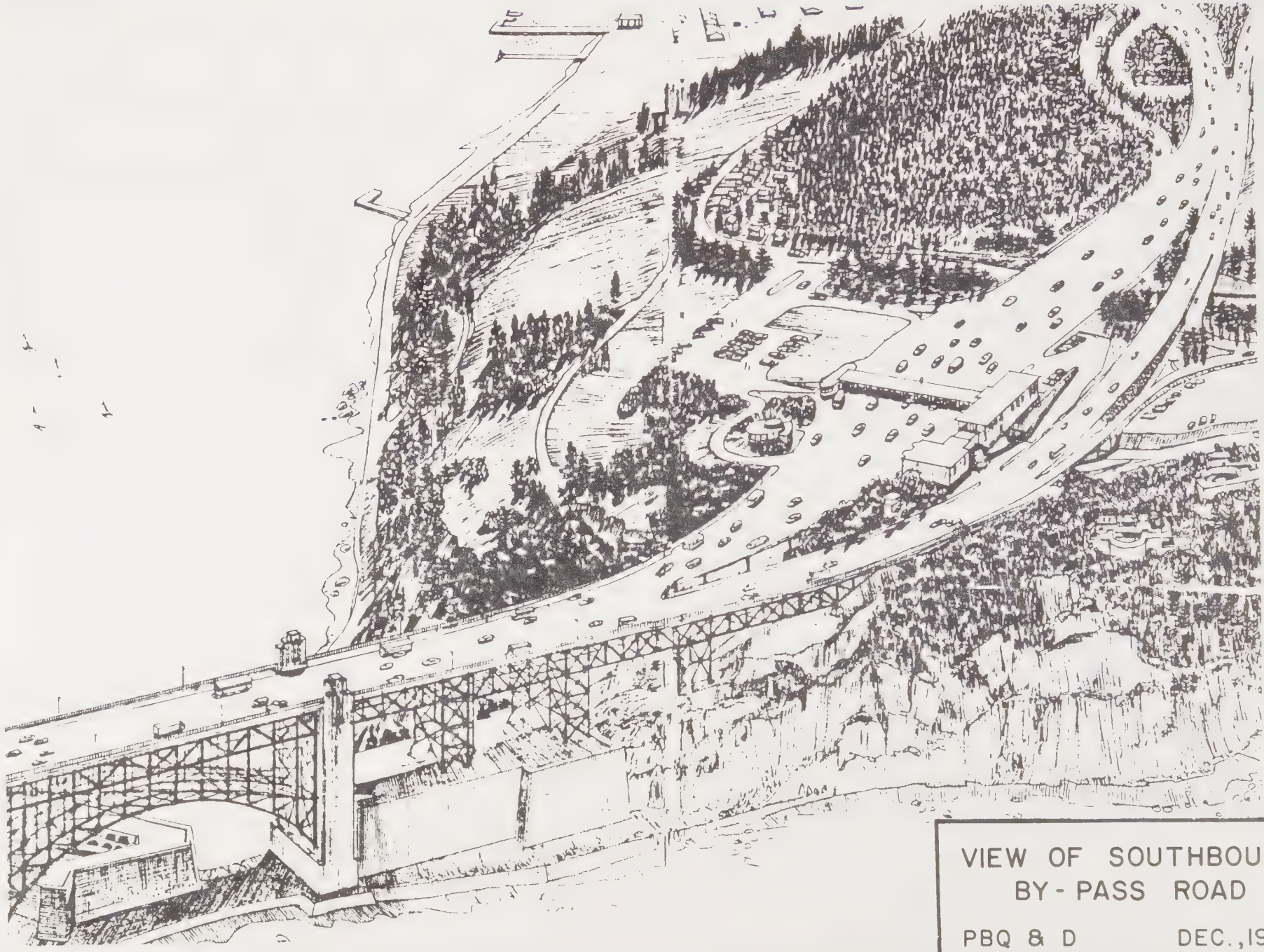


FIGURE 3



ROUTE MAP

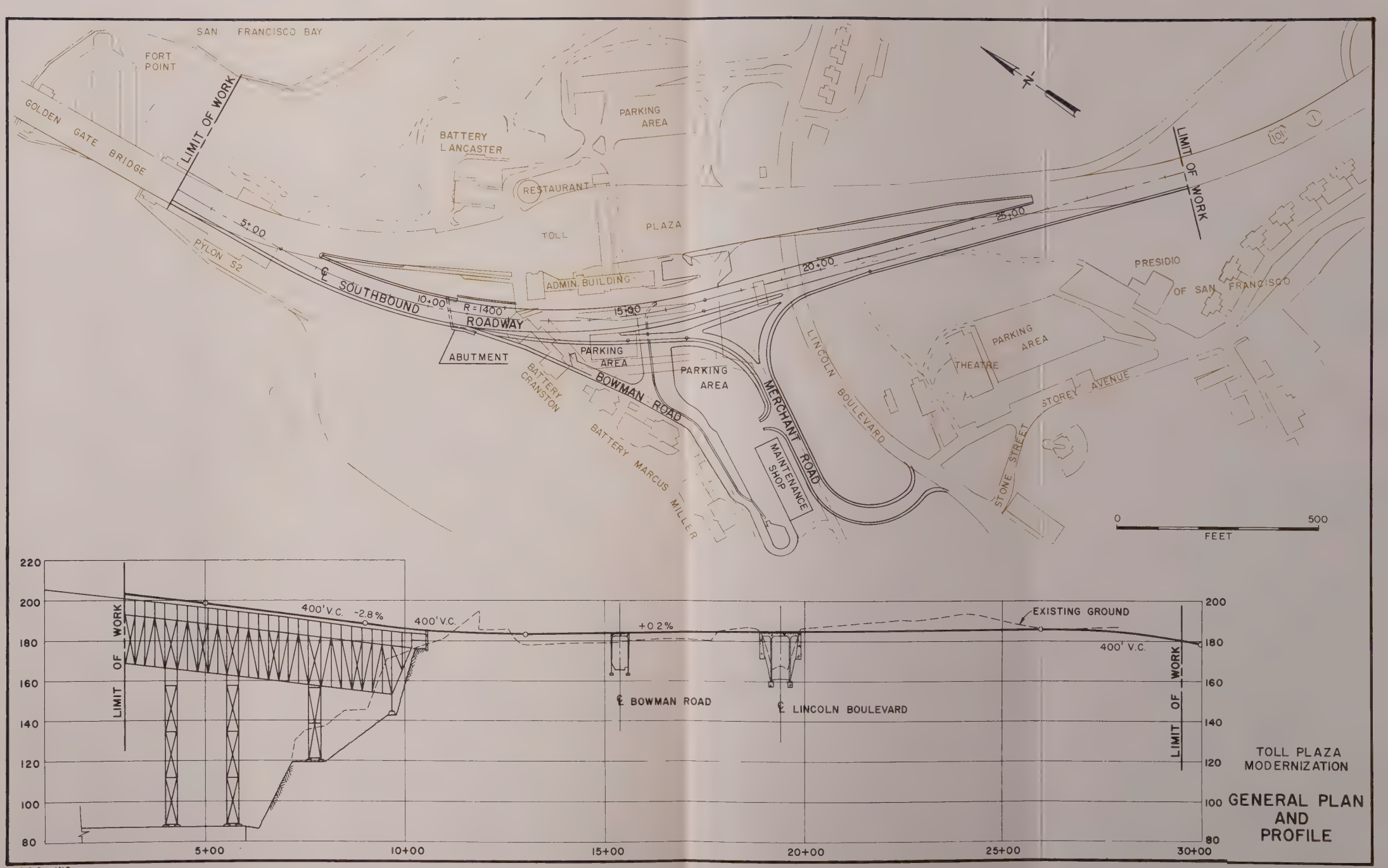
FIGURE 4



VIEW OF SOUTHBOUND
BY-PASS ROAD

PBQ & D DEC., 1970

FIGURE 5

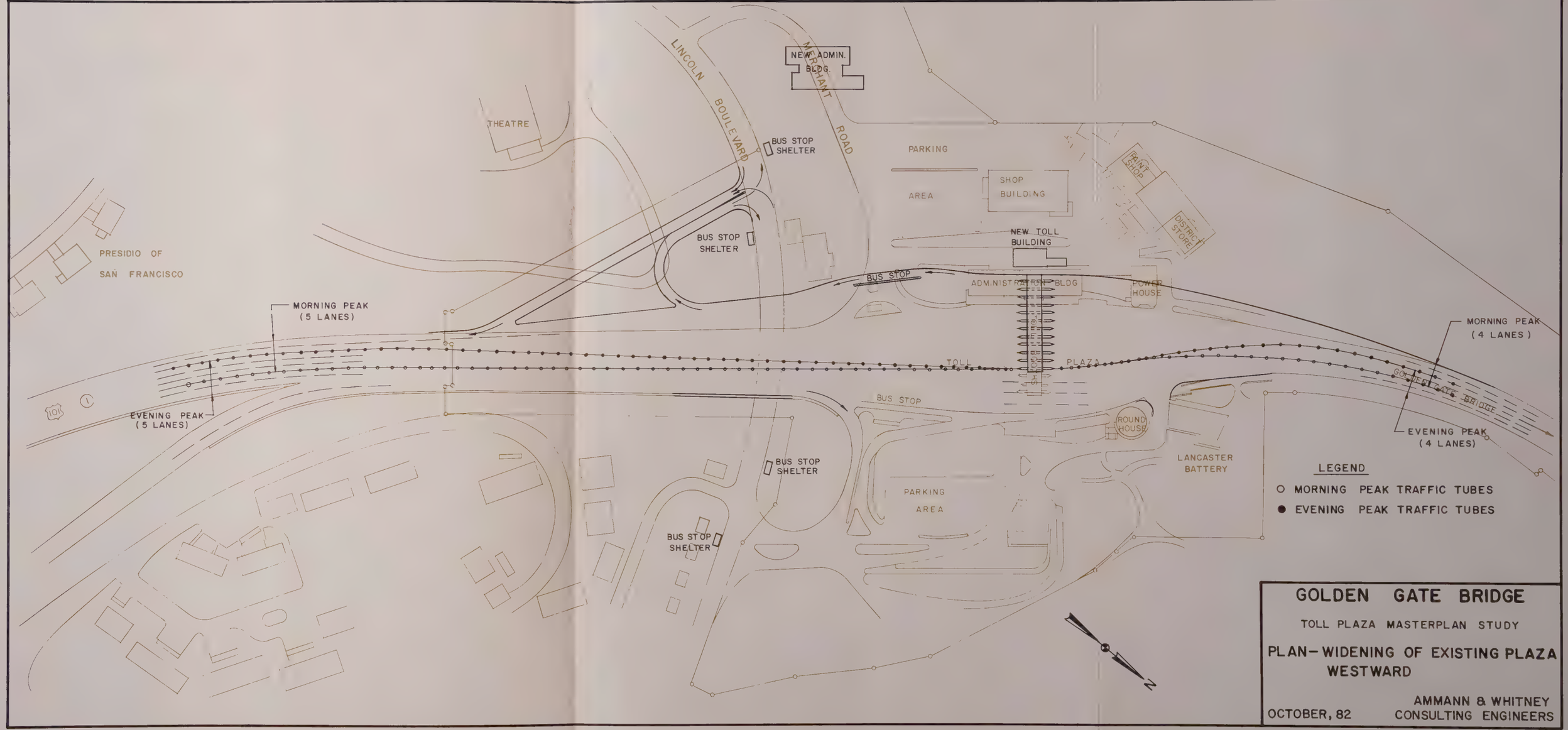


TOLL PLAZA MODERNIZATION

GENERAL PLAN AND PROFILE

PBQ&D, INC.

FIGURE 6



GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

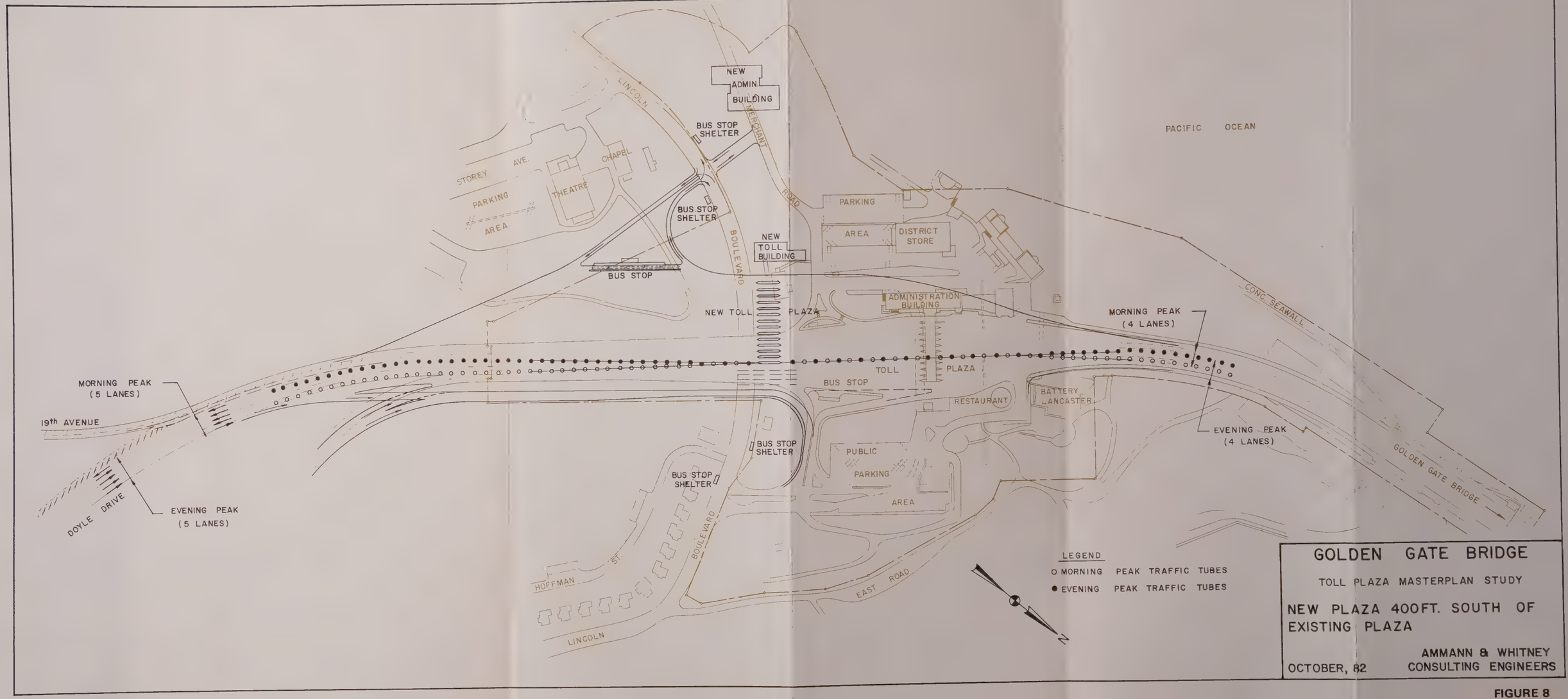
PLAN – WIDENING OF EXISTING PLAZA WESTWARD

OCTOBER, 82

AMMANN & WHITNEY
CONSULTING ENGINEERS

FIGURE 7

SFCA - 0094



GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

NEW PLAZA 400FT. SOUTH OF EXISTING PLAZA

OCTOBER, 82

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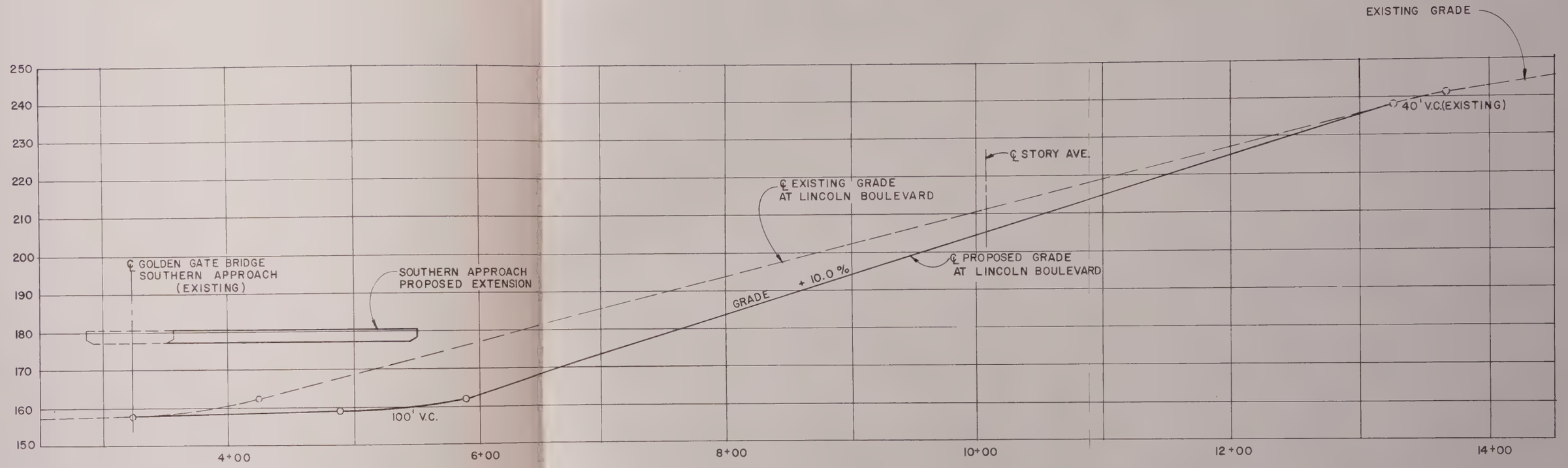
CONSULTING ENGINEERS

FIGURE 8



GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

LINCOLN BOULEVARD PROFILE

OCTOBER, 82

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FIGURE 9

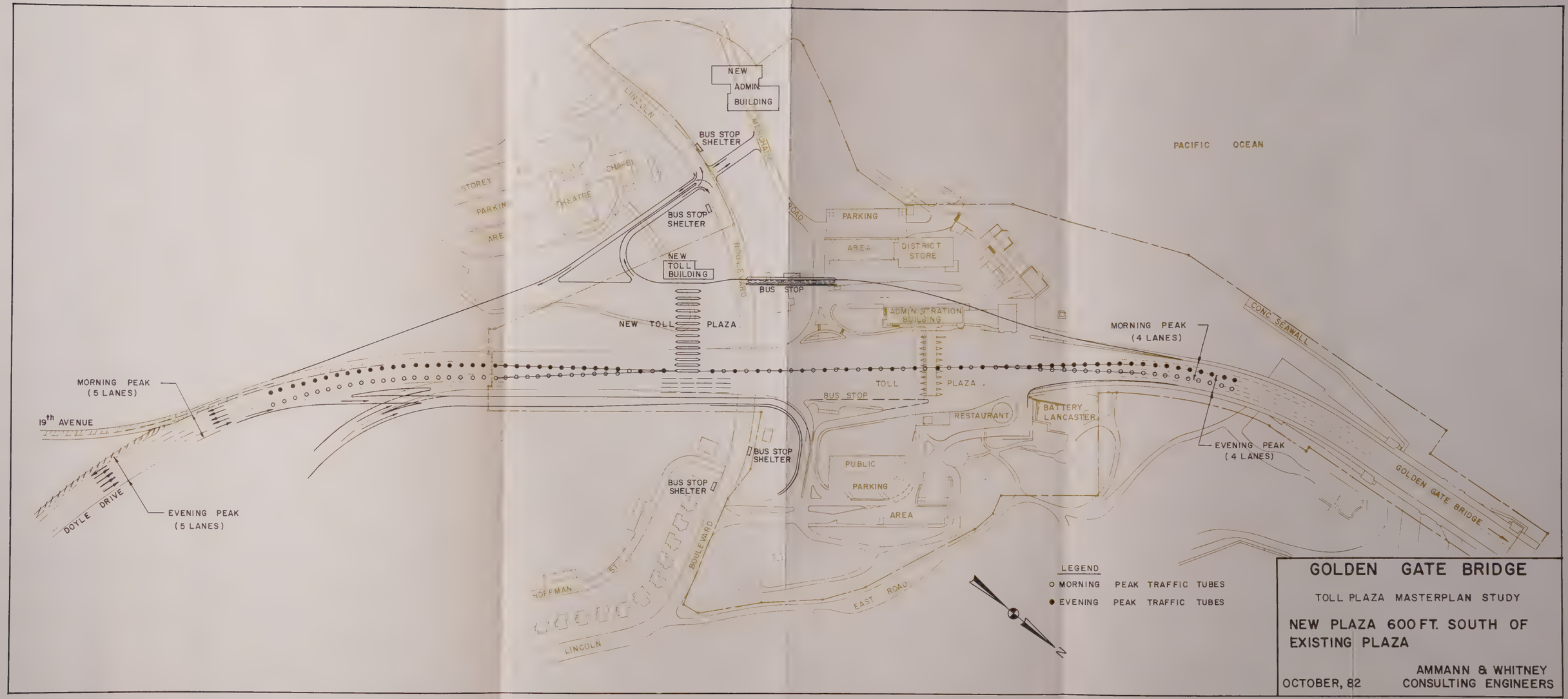
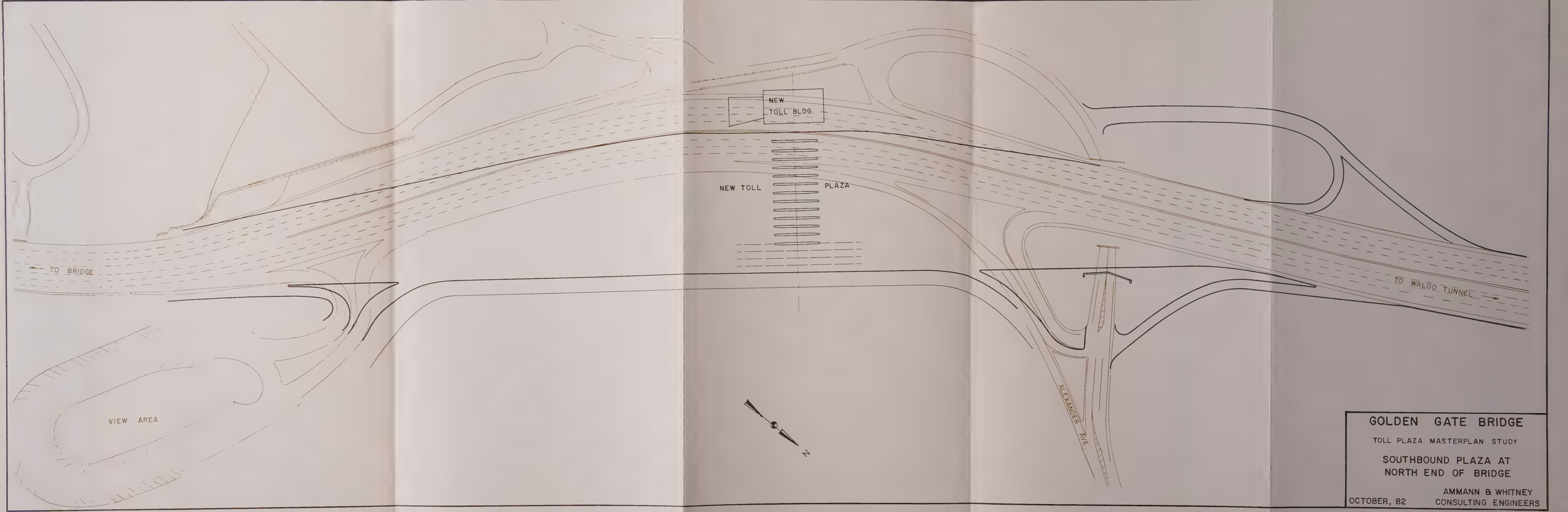

NEW ADMIN BUILDING
BUS STOP SHELTER
BUS STOP SHELTER
NEW TOLL BUILDING
BUS STOP
NEW TOLL PLAZA
MORNING PEAK (5 LANES)
19th AVENUE
DOYLE DRIVE
EVENING PEAK (5 LANES)
BUS STOP SHELTER
BUS STOP SHELTER
PACIFIC OCEAN
PARKING AREA
DISTRICT STORE
ADMIN'STRATION BUILDING
MORNING PEAK (4 LANES)
CONC. SEAWALL
TOLL PLAZA
BUS STOP
RESTAURANT
BATTERY LANCASTER
EVENING PEAK (4 LANES)
GOLDEN GATE BRIDGE
PUBLIC PARKING AREA
EAST ROAD
LINCOLN
BOULEVARD
HOFFMAN ST.
LEGEND
O MORNING PEAK TRAFFIC TUBES
● EVENING PEAK TRAFFIC TUBES
N
GOLDEN GATE BRIDGE
TOLL PLAZA MASTERPLAN STUDY
NEW PLAZA 600 FT. SOUTH OF EXISTING PLAZA
OCTOBER, 82
AMMANN & WHITNEY CONSULTING ENGINEERS

FIGURE 10



GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

SOUTHBOUND PLAZA AT
NORTH END OF BRIDGE

OCTOBER, 82

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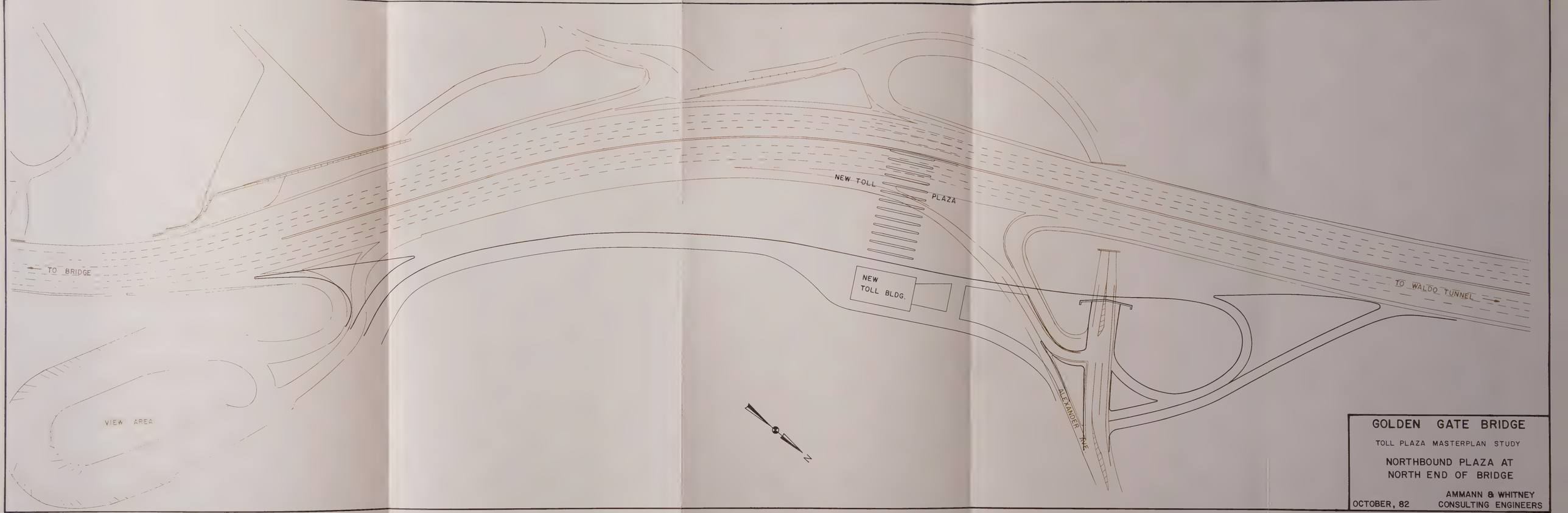
CONSULTING ENGINEERS

FIGURE II



GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

NORTHBOUND PLAZA AT
NORTH END OF BRIDGE

OCTOBER, 82

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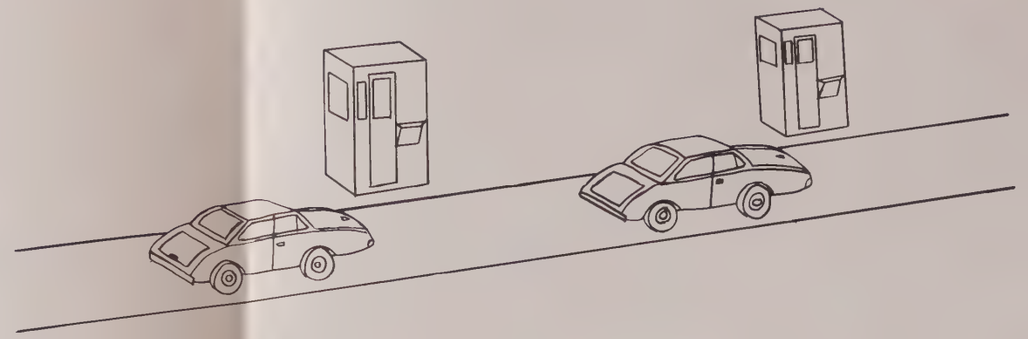
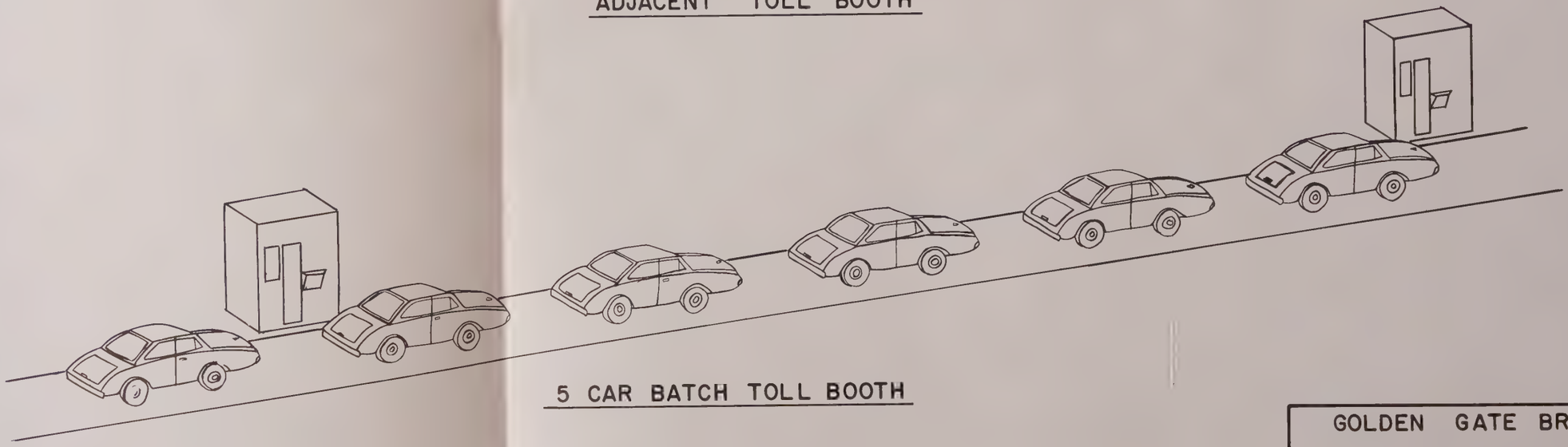
FIGURE 12



ADJACENT TOLL BOOTH



5 CAR BATCH TOLL BOOTH

GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

TANDEM TOLL BOOTHS CONCEPT

OCTOBER, 82

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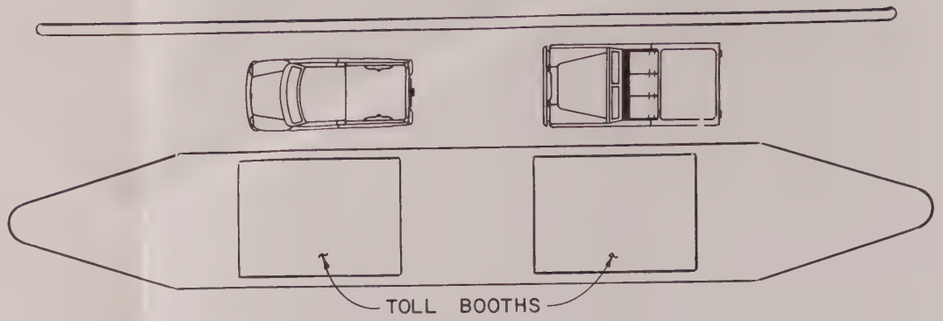
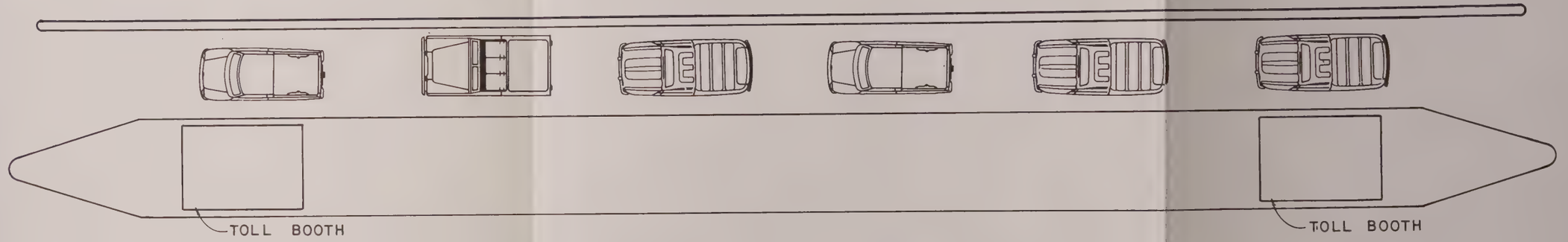
CONSULTING ENGINEERS

FIGURE 13



ADJACENT TOLL BOOTH



5 CAR BATCH TOLL BOOTH

GOLDEN GATE BRIDGE

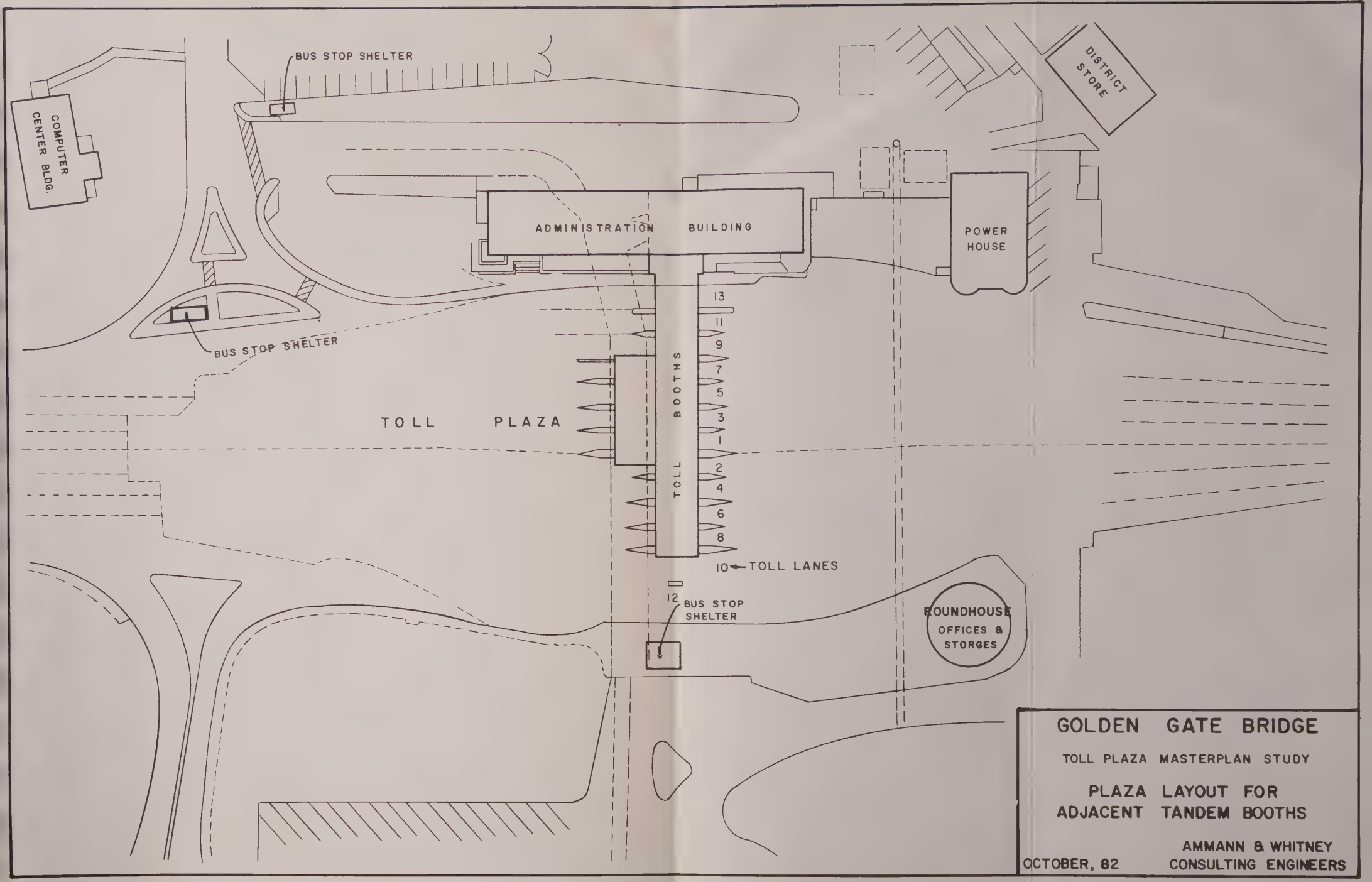
TOLL PLAZA MASTERPLAN STUDY

TANDEM TOLL BOOTHS
TOLL CONFIGURATIONS

AMMANN & WHITNEY
CONSULTING ENGINEERS

OCTOBER, 82

FIGURE 14



GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

PLAZA LAYOUT FOR ADJACENT TANDEM BOOTHS

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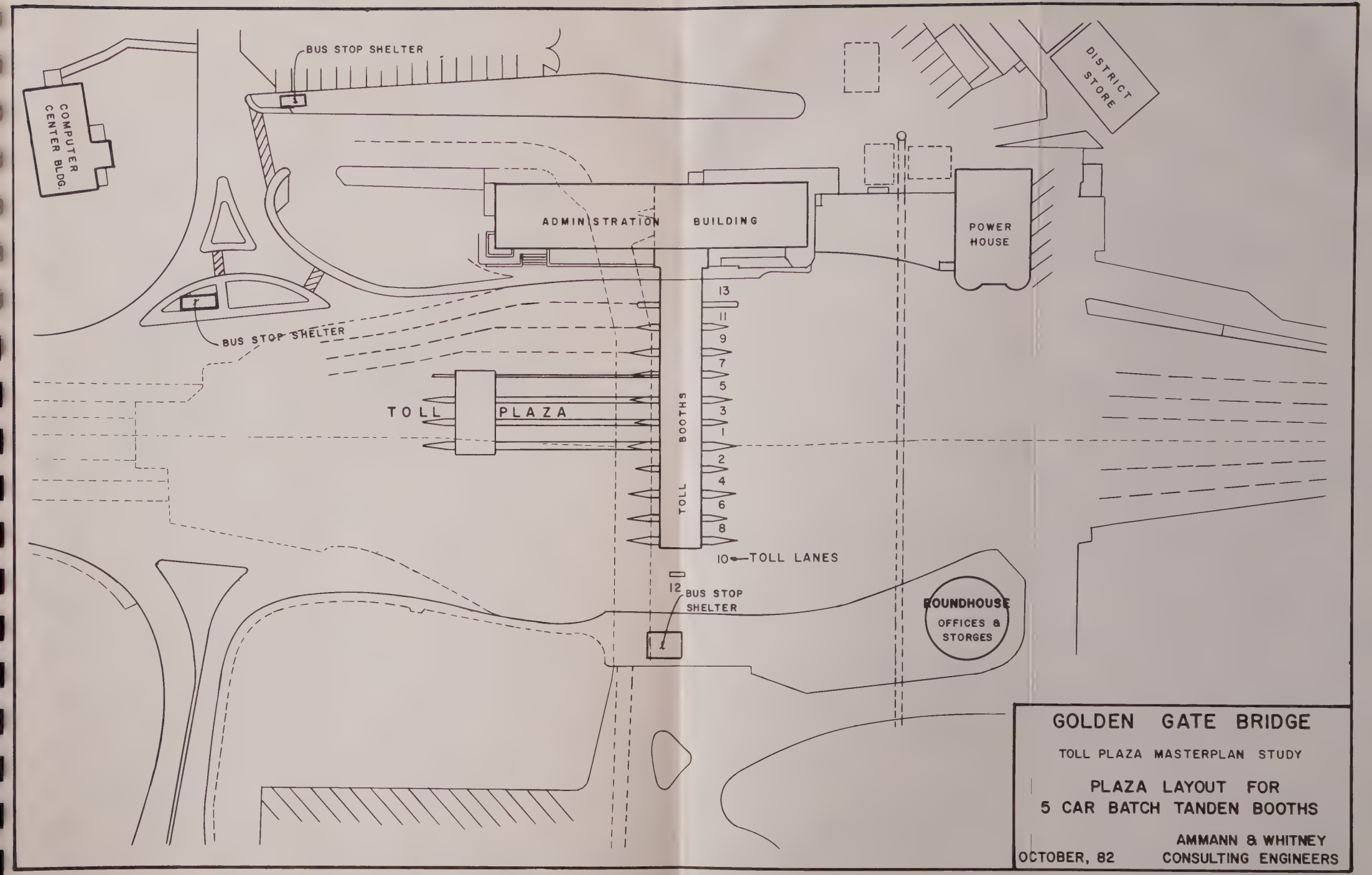
FIGURE 15



GOLDEN GATE BRIDGE

TOLL PLAZA MASTERPLAN STUDY

PLAZA LAYOUT FOR 5 CAR BATCH TANDEN BOOTHS

OCTOBER, 82

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CONSULTING ENGINEERS

FIGURE 16

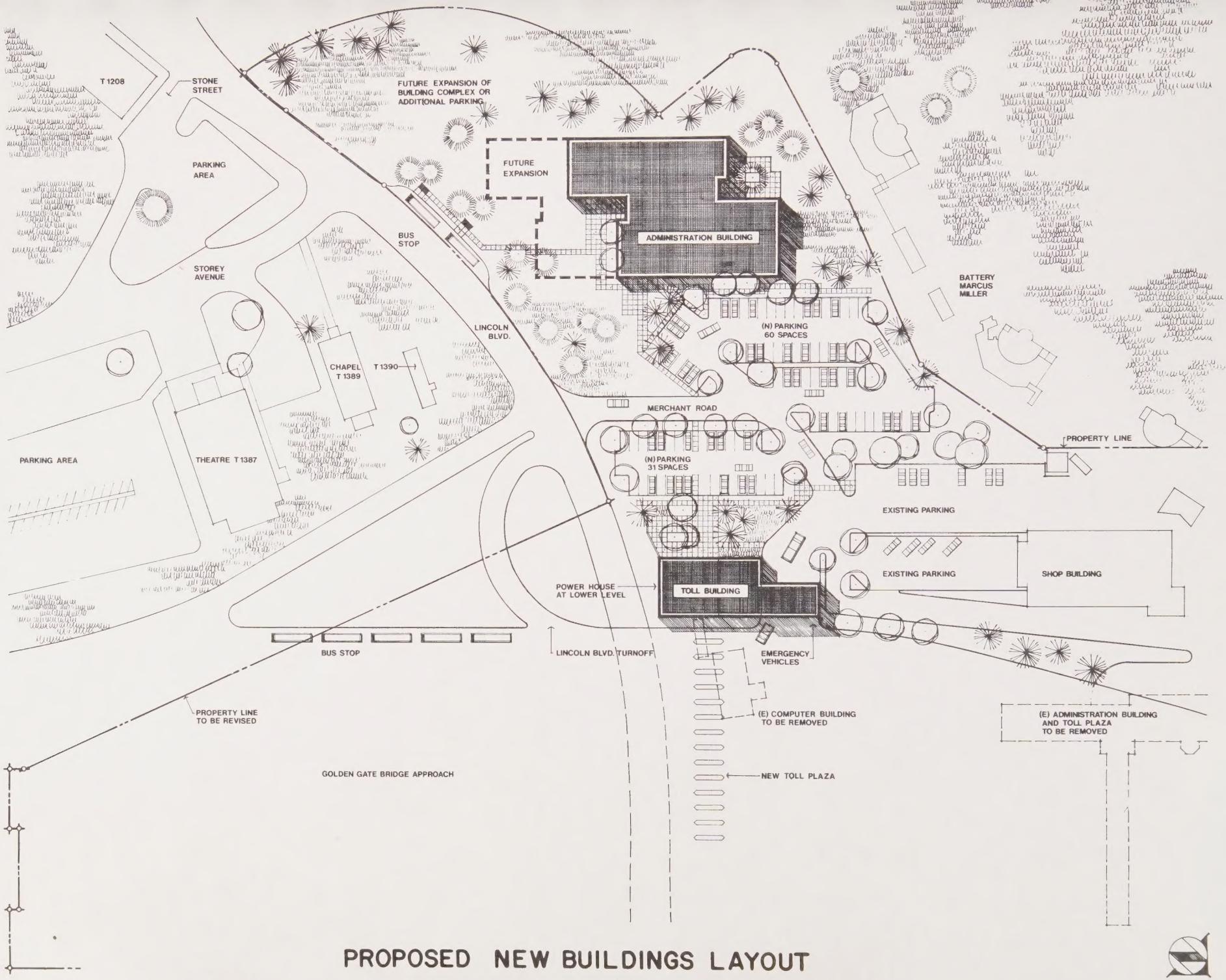

FIGURE 17

PROPOSED NEW BUILDINGS LAYOUT